IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

Ionosphere Station Information Bulletin No. 33**

* Under the auspices of Commission G Working Group G.1 of the International Union of Radio Science (URSI).

** Issued on behalf of INAG by World Data Center A for Solar—Terrestrial Physics, National Oceanic and Atmospheric Administration, Boulder, Colorado 80303, U.S.A. The bulletin is distributed to stations by the same channels (but in reverse direction) as their data ultimately flow to WDC-A. Others wishing to be on the distribution list should notify WDC—A.

I. Special Notice

added by: J. Virginia Lincoln, Director WDC—A for STP

As of this time it is uncertain that the Solar—Terrestrial Physics Division and Data Studies Division of the National Geophysical Solar-Terrestrial Data Center of the Environmental Data and Information Service of the National Oceanic and Atmospheric Administration will continue beyond the end of September 1981 This of course means the collocated World Data Center A for Solar—Terrestrial Physics (WDC—A for STP) as well. This is part of the major proposed U.S. Federal Government personnel and budget reductions. *This information is being shared with you before the final decisions are reached since new arrangements may become necessary for the submission of your data to the World Data Center system. We shall keep you informed.* It would also mean that some other group would have to undertake the preparation of the manuscript and printing of these Bulletins. WDC-A for STP has been happy to have provided these services to the worldwide ionospheric community since 1978.

II. Chairman's Introduction

by

W. R. Piggott, Chairman

This is the last INAG Bulletin you will receive in time to give a considered response to the URSI General Assembly at Washington, August 18-19th, 1981 . This meeting is especially important for the future of INAG.

We have to decide:

(a) Should INAG continue for another three years?

(b) If so, who should be Chairman and who Secretary?

(c) Should the Bulletin be continued and if so, how is it to be financed and produced?

These matters have been discussed in Bulletin 32. *Please brief your delegates on the action you prefer remembering that the easiest solution is to dissolve INAG. If you cannot do this please write to the Chairman Dr. W. R. Piggott, 21 Hillingdon Rd., Uxbridge, Middlesex UB10 OAD, U.K as soon as possible so that he can bring your views to the attention of the URSI.*

For those who will be in Washington before the opening of URSI, the Chairman will be available to lead a discussion on High Latitude phenomena on Saturday, August 8. Bring as many ionograms to illustrate your points as possible. If time allows and suitable contributions are present we would also like to have a discussion on Low Latitude ionograms. As always the Chairman would like to see ionograms which have given you problems. This will be held on Saturday, August 8 and can be continued on Sunday, August 9 if this is wanted by any participants. The time and place of the INAG meeting during the Assembly will be announced at the Assembly.

The Chairman will be available at the beginning of the IAGA Scientific Assembly August 3—5 in Edinburgh so that those who are attending IAGA and will, therefore, not be able to attend URSI will have an opportunity to express their view, discuss High and Low Latitude problems and raise any other problems. Details will be available at the University of Edinburgh. There was not enough support to justify a pre—IAGA meeting. INAG cannot operate effectively unless it is kept in touch with the current problems at the stations and the changing needs of the scientists and engineers who use the data. Experience shows that meetings are the best way of solving this problem but they are only effective if those attending have been adequately briefed.

Since there are often considerable delays between the dates when stations operate and the dates when the data are available in the WDCs, it is very difficult to get an overall picture of the VI network. Instrumental difficulties sometimes result in a gap in the data and the WDCs are seldom informed whether this is likely to be temporary or not - often the Administration involved does not know how long the problem will take to solve. *Please send details of your networks via your representative — it is very useful to the users to have up-to-date statements about which stations are working, which temporarily closed, which will be started in the near future and which have definitely closed.* In general the network appears to be in reasonable shape with the number of new stations contributing data almost in balance with the number of stations closed. Unfortunately most of the closings are of stations which have had long sequences of data so that it is getting more and more difficult to monitor long period changes in the ionosphere and on the Sun. This point will need your consideration before the General Assembly. Developments in digital ionosondes have aroused new interest in the use of ionosondes for research purposes with sufficiently broad participation to justify the setting up of a special working group at the past General Assembly, IDIG, International Digital Ionosonde Group, Chairman Dr. Dudeney (INAG 29, p. 9—32). This will be meeting at the General Assembly and we hope that many INAG members will attend. However, there is much that can be done with simple equipment and existing possibilities in morphological studies can be exploited even where facilities are very limited. Very few active scientists realize the possibilities which have not been studied, assuming that a field which has been very active for 58 years will be worked out. This is certainly not true. *There is a need for someone to do the necessary new analyses and to publish in the literature — others will then follow the lead if it is sufficiently novel.*

This three year period has found the Chairman exceptionally busy owing to his retirement from the British Antarctic Survey, and this has had an unfortunate effect on the production of Bulletins. However, Bulletin 29 was more than twice the average length of a normal bulletin so in effect we have produced 6 normal issues so far.

however, the number of meetings associated with INAG reported in the Bulletins to the Network has again reached last period's peak of eight. Overall our activity has been well maintained. As I pointed out in Bulletin 32, we need evidence that the Bulletins are useful both to convince our sponsors and to encourage those responsible for producing them.

I have contributed some notes designed to draw attention to points which should be discussed at URSI. The objective is to provoke informed discussion. For example most of the examples of cusp phenomena I have seen can be easily distinguished from other auroral oval phenomena but the High Latitude Supplement suggests that difficulties could arise in some sectors. Are these real?

I would like to draw your attention to the Japanese ionogram illustrated training manual, an excerpt of which is given on p. 19. We need your support to get this translated and published.

It is a great pleasure to publish an appreciation of our Secretary provided by Prof. Sir Granville Beynon, F.R.S. Sir Granville has been a great leader of international cooperation in ionospheric and solar—terrestrial physics and needs no introduction.

III. J. Virginia Lincoln

by

Prof. Sir Granville Beynon, F.R.S.

In the world-wide community of Solar-Terrestrial Physics workers there can be few who, at some time or another, have not been indebted to a World Data Centre for assistance with the supply of data and it can confidently be stated that anyone who has been indebted to WDC—A for STP has almost certainly been indebted to Miss Virginia Lincoln.

Virginia Lincoln's life—long career in Solar—Terrestrial Physics started in 1942 with the U.S. National Bureau of Standards in the field of radio propagation forecasting and in particular in the forecasting of disruptions to HF radio communication by solar and geomagnetic disturbances. Over the years improvements in forecasts depended increasingly on more complete geophysical data and 1955 saw the start of the now famous yellow book series "Solar Geophysical Data". For the quarter of a century that has elapsed since 1955 Virginia Lincoln has been the guiding light and driving force behind this immensely valuable series of monthly data reports.

The decade 1955—65 witnessed not only two major world-wide cooperative scientific enterprises — the IGY 1957-58 and the IQSY 1964-65 - but also saw the start of the space age, events which between them completely transformed the geophysical scene and in particular transformed the scale of geophysical data production, collection and distribution problems. In 1966 Miss Lincoln was appointed Director of the World Data Center for Ionosphere and Airglow at Boulder (later enlarged to become WDC—A for STP) and it was under her guidance that the activities of the Center greatly expanded to meet the needs of an ever larger and more demanding community of users.

During the International Years of the Quiet Sun (IQSY 1964-65) it was decided to designate retrospectively periods of especially interesting STP conditions (Retrospective World Intervals) and in 1967 at an IAGA meeting in St. Gallen, Virginia Lincoln presented an important pioneer paper in which she showed what could be accomplished in this direction. At this meeting too she offered to receive, edit and publish data from the whole world STP community for such intervals as might be designated by the responsible ICSU international committee — (first IUCSTP and later SCOSTEP). This was the beginning of the long series of UAG Reports published by WDC—A of which perhaps the most notable was UAG—2B a 932 page document covering the, exceptional geophysical events of August 1972. If she had done nothing else this series of special reports would have long stood as a worthy example of the energy and dedication of Virginia Lincoln. However, she has left her mark with at least two other international publications — the "STP Calendar Record" and the "International Geophysical Calendar'. For some twenty years the STP Calendar Record has provided a concise and convenient summary of the STP events and the annual "International Geophysical Calendar" (the origins of which go back to the "International Days" of the Second Polar Year of 1932—33) provides the basis for advance planning of all manner of international short-term cooperative exercises.

In addition to her substantial contributions to geophysical data publications Virginia Lincoln has, since the earliest days, been closely involved with the world network of ionosondes. She has been Secretary of the Ionosphere Network Advisory Group (INAG) for the eleven years since it was first established by URSI in 1969 and the operating staffs of ionosonde stations the world over owe her a debt of gratitude for her work in helping compile the 33 issues of the INAG Bulletin which have appeared in this period.

This short statement does not cover all that Virginia has done for radio and geophysical science —thus she has long been Secretary of CCIR Study Group VI (Ionosphere Propagation), has been leader of a IAGA Working Group on Geophysical Indices and has industriously and diligently carried out many other duties in national and international, governmental and non-governmental circles. She will be greatly missed.

In expressing the gratitude of solar—terrestrial physicists everywhere to Virginia it is perhaps not inappropriate to recall that in 1630 a Lincoln emigrated from Hingham, England and (among other things) founded Hingham, Massachusetts. There were five sons - a certain U.S. President was descended from one of them — Jeannette Virginia is a descendent of another. It has been said that to mention the name "Lincoln" in American political circles generally conjure up 'Abraham", but do so in STP circles and everyone knows that you mean "Virginia"!!

I know I speak for the whole ionospheric and Solar—Terrestrial Physics community in according Virginia Lincoln our deepest thanks for a lifetime of dedicated service and we wish her a long and happy retirement.

IV. INAG Meetings August 1981

There will be an INAG meeting to discuss High Latitude phenomena and the proposals at the IAGA Edinburgh Assembly on Monday August 3, 1981. A notice will be put up giving the room number. The meeting will start at the beginning of the afternoon session and can be reconvened for the evening session if there is enough support. Ad hoc meetings with individuals or small groups can be arranged on August 4, if desired.

There will be an INAG symposium meeting at Washington on Saturday, August 8th, starting at 10:00 am and lasting all day . Please bring ionograms. This can continue on Sunday, August 9th, if the participants so desire.

There will be an INAG business meeting during the General Assembly on a date to be announced. Decision on the future on INAG must then be taken and INAG proposals adopted or rejected. *If you cannot come, try to inform your National Representative of your views or write to the chairman.*

V. Notes for Discussions at INAG Meetings

(1) Identification of auroral oval phenomena using ionograms

The following notes are intended to start discussion and form a basis for the pre—URSI General Assembly INAG meeting to discuss High Latitude phenomena as shown by ionograms.

There are several obvious objectives for such a meeting:

(a) To identify particular phenomena as seen at different stations and agree on a common description and definition.

(b) To draw attention to phenomena shown by ionograms which deserve further study.

(c) To construct rules whereby the changes in the diameters of the auroral oval can be simply monitored by ionosonde stations.

(d) To identify, if possible, criteria which can be used to distinguish between the outer auroral oval precipitation and trough zones and the rather similar zones present at higher latitudes.

My personal view is that it is useful to separate the auroral oval into four sectors which can overlap but are not necessarily coincident in the overlap regions. Do others also feel that this is useful?

I would suggest, as clearly different phenomena:

(i) The cusp precipitation zone centered on local magnetic noon

(ii) The evening sector of the auroral oval (iii) The morning sector of the auroral oval

(iv) The main substorm zone centered on local magnetic midnight. Under very quiet conditions, type (iv) activity disappears and (ii) (iii) can be followed through the midnight zone to give a closed arc. Does the same occur in the noon sector and, if so, under what circumstances?

Owing to pressure of work, I have not followed recent developments unless authors have sent me reprints so some of these comments may be out of date, or misinformed. *If you have more information, this is a chance to let us know.*

(i) Cusp Phenomena. There seems to be general agreement that the presence of cusp precipitation can be easily identified in summer months. The normal summer type of ionogram, or sometimes a typical auroral oval type ionogram, is replaced by an ionogram showing a low dense F layer, blanketing the former F1 and F2 structures. In the latter stages of large storms this can move to remarkably low magnetic latitudes (less than L= 4) . There are many examples in the High Latitude Supplement (H.L.S)

Does this phenomenon also occur in winter and if so, is it readily recognized? How does one distinguish this from the noon extensions of the am and pm structures (ii) (iii)? Does the latitude of the noon sector vary with season? Are there important solar cycle differences which should be noted?

(ii)(iii) Morning and evening sectors. In the F region, there seems to be general agreement that the characteristic feature is a sudden change in spread traces but in some cases class (i) has been given as a common feature. Do we all agree that this is misleading and that the distinction should be stressed? For night hours, the plasmapause trough is usually recognizable (replacement layer) but the common feature at all hours appears to be the high latitude ridge on the polar side of the trough. This has strong, field—aligned irregularities with maximum electron densities much greater than in the surrounding zones. There appears to be a sudden fall in scattering power when seen obliquely at a frequency corresponding to the critical frequency of the layer when overhead. The pattern seen at a given station varies with the dip angle at that station but probably rather slowly. Do we need examples of this?

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These have received less attention than the dramatic phenomena seen in substorms but may well become much more important in the future. These sectors of the auroral oval expand and contract as the solar wind pressure increases and decreases and show the recovery at the plasmasphere after a storm. Blanketing by sporadic E or blackout is much less important than in the midnight zone so the exact time when oval crosses the station can usually be found with adequate accuracy. Thus it appears that we can monitor the radius of the auroral oval by noting the times when the characteristic patterns appear and disappear at suitably placed stations. In so far as the noon sector cleft phenomena occur on the oval (the distinction is not important but I have seen a few cases where it seems to have been displaced seriously. There have been hints that the type of Es present changes as the station moves across I the oval and the Es is, of course, much more evident on the evening than on the morning sectors. Most high latitude Es statistics average over a wide range of conditions. There is much work to be done repeating them at constant position relative to the oval

The aircraft data (Handbook UAG 23 section 11.6 p. 260-270) show relations with the auroral oval and with auroral arcs, but only on a few occasions. Do we believe that these are representative from our VI data which are much more numerous and regular?

(iv) Midnight sector. The phenomena during a substorm vary rapidly in intensity and position with time and the VI data are often fragmented by blackout conditions. Apart from conventional analyses do we need to do further work as a network? At individual stations, of course there are interesting detailed connections between ionospheric phenomena as shown on ionogram magnetospheric phenomena and the associated particle streams, electric fields and auroral activity. These are likely to receive much local attention; particularly in conjunction with Incoherent Scatter Soundings, auroral radars, heating experiments and rocket and satellite data.

(2) International Geophysical Calendar — Recommended programs.

The questions of whether the recommended programs should be revised was discussed at the last General Assembly at Helsinki, but most participants did not feel sufficiently informed to express views. The Chairman felt that the recommendations should be amended to be more in accord with actual practice at the stations and that some effort should be made to economize an ionogram interchange.

He took action accordingly and you have received the revised tests with your copy of the Calendar. There has been no comment from the recipients but the Chairman feels that the action should be criticized or approved at the General Assembly.

The text for 1981 for Ionospheric Phenomena and for the associated Airglow and Aurora Phenomena is reproduced below. Your representatives will be invited to comment on and modify this text for future years and to approve it for 1981—82 at the INAG meeting. Please make your wishes known since otherwise INAG' is compelled to maintain the present text.

It is very important that samples of ionograms from as many stations as possible be available at the WDCs since these give the only evidence that the data are reduced to standard rules and often show phenomena not usually analyzed. INAG appeals to stations who have not contributed in the past to copy hourly ionograms for the four quarterly World Days so that some samples are available. Without these, many scientists have doubts about the reliability of the data.

There are now a considerable number of stations who make observations for their own research purposes only and do not contribute to the world data. In the early days such stations made special efforts to obtain a sequence over several days (depending on effort available usually 3 to 1) at the equinoxes and solstices

Such samples were often worthwhile as a guide to probable ionospheric conditions when special experiments were planned and were, of course, very valuable as a guide to ionospheric conditions in zones where few ionosondes existed. Would there be any response to an attempt to restart this and if so should a note be added to the Calendar? What is your view? A similar situation arises with the new digital ionosondes which are, at present, primarily research tools. It is very important that some systematic work is done to find out how to use these most efficiently in synoptic modes and it might be valuable if their owners could evaluate such problems by making limited sequences at the equinoxes and solstices.

Recommended Scientific Programs 0perational Edition

Airglow and Aurora Phenomena. Airglow and auroral observatories operate with their full capacity around the New Moon periods. However, for progress in understanding the mechanism of, inter alia, low latitude aurora, the coordinated use of all available techniques, optical and radio, from the ground and in space is required. Thus, for the airglow and aurora 7-day periods on the Calendar, ionosonde, incoherent scatter, special satellite or balloon observations, etc., are especially encouraged. Periods of approximately two weeks' duration centered on the New Moon are proposed for high resolution studies of ionospheric, auroral and magnetospheric observations at high latitudes during northern winter.

Ionospheric Phenomena. Special attention is continuing on particular events which cannot be forecast in advance with reasonable certainty. These will be identified by Retrospective World Intervals. The importance of obtaining full observational coverage is therefore stressed even if it is possible to analyze the detailed data only for the chosen events. In the case of vertical incidence sounding, the need to obtain the quarter—hourly ionograms at as many stations as possible is particularly stressed and takes priority over recommendation (a) below when both are not practical

For the vertical incidence (VI) sounding program, the summary recommendations are: (a) all stations should make soundings at least every quarter hour. Stations which normally record at every quarter should, if possible, record more frequently on RWDs; (b) all stations are encouraged to make f—plots on RWDs; f—plots should be made for high latitude stations, and for the so-called 'representative" stations at lower latitudes for all days (i.e. including RWDs and WGIs) , (Continuous records of ionospheric parameters are acceptable in place of f—plots at temperate and low latitude stations); (c) all stations are encouraged to make profile parameters on RWDs and include them in data sent to WDCs except for stations which already undertake full profile programs or produce monthly median profiles for synoptic purposes; (d) copies of hourly ionograms with appropriate scales for QWDs are to be sent to WDCs; (e) stations in the eclipse zone and its conjugate area should take continuous observations on solar eclipse days and special observations on adjacent days. See also recommendations under Airglow and Aurora Phenomena.

For incoherent scatter observation program, every effort should be made to obtain measurements at least on the incoherent Scatter Coordinated Observation Days, and intensive series should be attempted whenever possible in WGIs or the Airglow and Aurora Periods. The need for collateral VI observations with not more than quarter-hourly spacing at least during all observation periods is stressed. Dr. M. Blanc (France), URSI Working Group G.8, is coordinating special programs.

For the ionospheric drift or wind measurement by the various radio techniques, observations are recommended to be concentrated on the weeks including RWDs.

(iii) MUF factors and MUFs

The International MUF factors were originally a compromise, made in 1942-3, between differing theoretical analyses. There is, therefore, no physical reason why they should be "right" or the best compromise for practical applications.

In practice, they have been remarkably successful and most workers have felt that there was no point in trying for a better set. Any change would cause widespread confusion and dislocation and tests suggest that experimental error in using them is still the main source of error. In theory it would be possible to set up a series of representative models, do full ray traces through them by computer, deduce the effective MUF factor and average over models. The arbitrary element is the choice of model and averaging rule. Experience with N(h) profiles suggests that there would be no consensus on these and hence one arbitrary set would be replaced by another arbitrary set. Thus no action.

There are, however, some points which need clarification, or where some action may be desirable. While in theory all stations use the same factors, in practice this is not true. Sometimes this occurs by accident, the most common being a change in the height scale of the ionogram without a corresponding modification to the overlay or slider. Departures of frequency scale from that adopted in calculating the curve can also be important. However, some networks have used their own factors for many years, often without knowing that they were not standard'. For examples, sliders provided for C2, C3, C4 ionosondes are usually non-standard by a small amount.

Where this has occurred it would be valuable to construct a standard overlay, make a set of measurements spread over a wide range of conditions and compare the factors obtained. If anyone tries this, INAG would be glad to publish the results in the Bulletin.

Undoubtedly the main real point of ignorance is in the MUF factors for the F1 layer. Unless this is showing a true maximum (cusp—like ionogram) both of the methods of determining the factor theoretically and its best value are unknown. We badly need some ray tracing experiments on F1 layers comparing the calculated and slider deduced MUFs. For example is the best value of foF1 to be used the value given by the ionogram or is any correction desirable?

At a recent meeting to discuss C.C.I.R. problems I was astonished to find that the difference between normal E—layer factors and sporadic E factors appears to have been forgotten! The physics is very simple. For a thick layer about one third of the trajectory is in the layer so the wave goes to a longer distance than it would have done for a thin reflector. This is equivalent to saying that the factor for a given distance is smaller than for a thin layer. In the case of E, Es the ratio of the factors is, on average, about 1.1, i.e. Es MUF is 10% larger than an E MUF for the same value of critical frequency and height of maximum. This is one of the many reasons why Es is always much more evident at oblique than at vertical incidence. When Es is below hmE, as often occurs for the denser forms, the factor is even larger.

Experiments suggest that using the standard factors slightly underestimate the MUF, the error slowly increasing with distance.

(iv) International interchange of data: N(h) profile parameters

The international programs for interchange of data were given in Chapter 9 of UAG—23, the Handbook, with the revised characteristics in section 1.6 p. 25—26, UAG—23A. They have been periodically updated in the Guide to International Data Exchange through the WDCs (latest 1979). However, they are still essentially as formulated for the IGY.

While most of the recommendations have been widely adopted, some nave never had much support, in particular, recommendations involving electron density profile data. Most work involving such parameters has been done centrally either by requesting ionograms or by using techniques based on the tabulated parameters foF2, foF1, foE, M3000 F2, h'F, and h'F2. The literature shows that a few groups have used profile parameters, for special studies but have not used them regularly.

Although containing much detailed advice which will need to be adapted in any future instructions, Chapter 10 of the Handbook "Electron density parameters and profiles' is now obsolete. A new guide is in preparation by the Chairman of the N(h) working group, but will not be available for some time.

In view of the lack of support for N(h) interchange in the past the Chairman, in his personal capacity would like to suggest that all N(h) profile recommendations be removed from the next revision of the Guide. If and when the present interest in computer controlled digital ionosondes has generated new interest and the workers have formulated a workable interchange scheme a new set of recommendations should be prepared and adopted internationally.

The detailed proposal is therefore that p. 23 of the current Guide to International Exchange be modified by removing Recommendation f and relettering as necessary *The attention of IDIG should be drawn to this proposal.*

At Helsinki the N(h) problem was given to Working Group G5. "True height reduction techniques' and it is obviously of direct interest to G10 "IDIG" so there is little danger of it being ignored. However, the interests of the isolated group with few resources are always liable to be overlooked. It is, therefore, important that INAG be informed of any interest in N(h) parameters by such groups which would justify amending Chapter 10 or adding text to that produced by Working Group G5.

The technical position at the end of the last URSI General Assembly at Helsinki has been summarized, with many references, by Dr. L. F. McNamara, the Chairman of the N(h) Group G 6.2. This is available to those interested as UAG 68, 1978 'A comparative study of methods of electron density profile analysis".

<u>International Quality symbols I I*</u>

A similar situation has occurred with the International Quality symbols I I* which were devised to identify high quality stations (p. 24 of WDC Guide para (i))

Since, despite several recommendations, no stations have volunteered for key station status or have used the international quality symbols I, I* this recommendation should also be withdrawn at Washington. In detail we recommend that para (i) p. 24 be deleted.

INAG has debated the key station concept many times. It is very popular with users of the data. However, despite much effort, it has never proved possible to make it work in the network as it actually is.

<u>Abstract from Fourth Consolidated Guide to International Data Exchange June 1979</u>:

B. <u>Ionospheric Phenomena</u> (other than flare—associated events, treated in C)

6.1 Ionosphere Vertical Soundings

a. Ionosonde observatories should send to one or preferably all WDCs copies of the results of their observations according to the program adopted as detailed under sections (d) to (f) below. Dr. W. P. Piggott (address: British Antarctic Survey, Madingley Road, Cambridge CB3 GET, England), Chairman of the Ionosphere Network Advisory Group (INAG) (Working Group G1 of Commission G of URSI) is willing to discuss any proposed variations in the standard programs in particular cases. The most local member of INAG may be consulted if more convenient.

b. Special stations with ionosondes which are operated on irregular schedules or primarily in connection with other experiments such as rocket launchings or incoherent scatter programs are requested to notify one of the WDCs annually or oftener of the general nature of their program since their last report. Preferably this notification should be in March and also at the end of each campaign or period of observation, or upon request from a WDC. This should include information on the periods of observation, the usual observing schedule during these periods, what systematic scalings are normally made and where the ionograms are kept. The WDC will catalog the information and refer any inquiries to the stations.

c. Automatic stations or stations which cast their data in computer format should provide data described in (d) to (f) below in equivalent form. The preferred form is a magnetic tape containing the data in such a form that the parameters in program A (see (d) below) and the detailed electron density profiles can be abstracted conveniently. It is valuable to add the appropriate geomagnetic data (Kp, Ap, local K or Q), where available, to the identifying parameters for each set of data. The data should be cast in formats compatible with the major computerized analysis groups so that data can be interchanged without confusion. Requests for station identification conventions and preferred codes and standards should be made to WDC-A.

d. Data reduction and interchange Program A (slightly modified from the corresponding IQSY program) is suited for high latitude stations and representative stations at lower latitudes.

It provides for:

(i) Monthly tables of hourly values, medians and quartiles of the following parameters:
foF2, foF1, foE, foEs, fbEs, fmin; fxI; h'F, h'Es, and where height accuracy allows, h'E; M(3000)F2 or MUF(3000)F2; Es types.
(ii) Hourly monthly median profiles.
(iii) f-plots for all days.

e. Data reduction and interchange Program B (slightly modified from the corresponding IQSY program) is suited for temperate and low latitude stations. It provides for:

(i) Monthly tables of hourly values, medians and quartiles of the following parameters:
foF2, foF1, foE, foEs, fbEs, fmin; fxI where practical; h'F, h'Es, and where height accuracy allows, h’E; M(3000)F2 or MUF(3000)F2; Es types.
(ii) Hourly monthly median profiles; copies of other profile data made regularly or plotted for particular events (storms, eclipses, Retrospective World Intervals, etc.) should also be deposited at WDCs.
(iii) f—plots should be prepared and provided for announced Retrospective World Intervals. Any f-plots made for other occasions should also be copied to the WDCs if possible.

*f. Data reduction and interchange Program C (slightly modified from IQSY Program D) is suited for stations which conduct mainly an electron density profile program. It provides for:

(i) Monthly tables of hourly values, medians and quartiles of the following parameters:
foF2, foF1, foE, foEs, fbEs, fmin; fxI where practical; h'F, h'Es, and where height accuracy allows, h'E; M(3000)F2 or MUF(3000)F2; Es types.
(ii) Hourly monthly median profiles in tabular form (N as function of height, or height of constant N).
(iii) Values of electron density with height for all occasions when special measurements by sophisticated techniques (rockets, satellites, incoherent scatter, etc.) are in use at or near the station. Hourly values have preference when it is not possible to reproduce all the available data.

g. For representative stations, regardless of whether the data reduction program is according to (d), (e), (f),it is recommended that:

(i) Copies of ionograms for at least the Priority Regular World Days (one day each month) be provided to one of the WDCs for interchange with the other WDCs; stations are encouraged to make arrangements with one of the WDCs for having copies of all their ionograms available; stations are invited to make available copies of ionograms on request for periods selected for special study, e.g., Retrospective World Intervals or other special projects.
(ii) Information on what other analyzed data are available from the ionosonde observations, with indication of parameter or type of observation and the periods involved, should be notified to one of the WDCs annually (e.g., in March) or oftener; where convenient, copies of such data should be sent regularly.
(iii) Reprints or preprints of reports or papers summarizing ionospheric behavior, dealing with special events or presenting regional or morphological studies should be sent to the WDCs
(iv) A statement at least annually (e.g., in March) indicating dates and times of significant changes in the ionosonde characteristics such as changes in frequency, height or timing calibrations or in the sensitivity of the equipment which could affect fmin, foEs or fxI should be sent to one of the WDCs.
(v) Whenever an old ionosonde is withdrawn from service or a new ionosonde is installed, or when there is change in performance, a special effort should be made to sent to WDCs:
(a) sample ionograms;
(b) frequency and height scales (or overlays); (c) M—factor overlays, if available. The WDCs should be apprised of the type of ionosonde, frequency range, peak power and date of first or last operation.
(vi) When station booklets are prepared the recommended sequence of tables, based on computer code order, is:
foF2, fxF2, fzF2, M(3000)F2, h'F2, hpF2, h'Ox, MUF(3000)F2, foF1, fxF1, M(3000)F1, h'F1, h'F, MUF(3000)F1, foE, foE2, h'E, h'E2, foEs, fxEs, fbEs, fEs, h'Es, Type Es, foF1.5, fmin, M(3000)F1.5, h'F1.5, fm2, hm, fm3, foI, fxI, fmI, M(3000)I, h'I and dfS.

h. New stations in particular are encouraged to circulate additional parameters, e.g., foE2, h'E2, M(3000)F1, or MUF(3000)F1, foF1.5, h’F1.5.

i. The attention of investigators is drawn to the use of international quality symbols I or I to denote data guaranteed to conform to the international standards. The URSI has recommended that those stations which are prepared to guarantee that international standards of data quality are maintained (see URSI Handbook of Ionogram Interpretation and Reduction, Report UAG—23, WDC-A,

*Proposed sections to be omitted.

November *1972),* should mark their data Quality I (for International) and stations using modified international standards (the particular modification being stated) should use the Quality symbol I*.

(v) Swedish Network meeting 20-22 January 1981

Following the death of Dr. B. Lindquist at the end of 1980, the Swedish scientists and scalers working with ionosondes held a meeting 20—22 Jan 1981 to discuss the situation in Sweden and to raise questions for INAG. The following abstracts from a letter from Harald Derblom to the Chairman summarize the main points raised:

Network

At present there seems to be no risk for closing any of the Swedish stations (Kiruna, Lycksele, Uppsala). During the eighties there will be a lot of scientific activity such as by EISCAT, HEATING, rocket launchings, TEC, etc., which need support from the ionosonde network. There is also a continued interest by the wave propagation people in the ionospheric data.

INAG

We are very anxious about the future of INAG and the INAG Bulletins. Ways should be found for a continuation since both INAG and the Bulletins seem to be the only interface between the scientists and scalers! operators on global scale. The Swedish national representative Professor Bengt Hultqvist has been contacted and asked to take up this matter at Washington. As soon as possible we will also take it up in the Swedish national committee for radio science (SNRV) . In addition we strongly support that ways should be found to finance the participation of the chairman of INAG in meetings where URSI or INAG business is discussed.

Bulletin policy

There is a general agreement that an interpretation of ionograms in Uncle Roys column containing some physics is to be preferred but the scalers view should not be forgotten.

Special problems

Simplification of scaling rules was discussed. Our feeling is that they should be simplified to a certain extent. The Es-types could be divided into three subgroups as suggested in INAG-32. Type k should definitely be out from the E-column. fmin could be deleted. h'E is ok. foEs should perhaps be exchanged to ftEs (top freq.). fbEs is ok. h'E is of less interest. foE is ok. Although it can be calculated from the sunspot number it may deviate from normal, for instance due to gravity waves. h'E2 and foE2 could be deleted or made optional as now. Our question is, however, how to indicate the gap between foE and the F-echo when E2 is present but not scaled? Could we, please, get an answer on that? h'F is ok. Regarding foF1 we agree that only clean values should be tabulated. h’F2 and foF2 are ok. There was a lot of discussion regarding fmI, fxI and dfS. We would like to simplify the life for the scalers but what should we do around the ionospheric “trough’ regions where we often see “two” ionospheres? What to do with the F-region spurs which might appear both below and above foF2? Is the parameter dfS (fxI - fmI) of any use or could we just skip it? There are a lot of questions left and I was asked to contact you and get your opinion about these parameters. Perhaps our questions could be taken up at the next INAG-meeting (if not earlier). It seems that nobody who is working directly with ionosondes will be able to attend Washington meeting from our country.

Chairman’s comments

Es types. I hope we can get a consensus at Washington on Es types. As far as I can tell, we have to arrange for a situation when all the stations who are having little or no difficulty will continue as at present but that those who wish for a simplification of the standard types h, c, l, f will adopt one type letter symbol w (world class) for these. Low Es with foEs < foE will then be ignored as suggested in previous discussions.

foES, ftES. To be useful it is necessary to keep the data consistent with one mode, either foEs or fxEs. The rules are equally complex in both cases though there are fewer examples where one has to subtract fB/2 than to add it. All stations were offered the choice in UAG-23, which gives both sets of rules, but in practice all, or nearly all, preferred foEs which can be used without knowledge of the appropriate value of B (often surprisingly difficult to find!). The Australian stations used ftEs for some years but found that the data were not being used as they were too misleading. It is often forgotten that, though foEs can vary over an enormous range, a large fraction is about 0.5Mhz above foE. Thus ignoring fB/2 in a random way introduces an error of order 100% in a large fraction of the data. There is a strong consensus that ftEs is practically valueless and not worth the trouble of tabulating. Thus there is only a choice between measuring foEs or not measuring it.

fmin. Even when fmin is not usable as a measure of absorption it is usually a good detector of instrumental faults and the table is useful in the computer handling of data, giving a check on all parameters which are missing due to being below it (EB; ES; EE cases). In the international interchange there are advantages in everyone making the same tables even when the physical measuring is small.

h'Es foE2 fminF > foE or fbEs. The principle is that we do not ask scalers to reduce features of the ionogram which are not afterwards used, so features between foE and fminF are only recorded when there is a local interest. Usually this is best met by tabulating foE2 h’E2. Remember the ionogram greatly exaggerates small changes in gradient so that very small changes in the upper part of E or tail of F show up clearly. Unless your scientists are actively studying E2, I would recommend dropping it and ignoring the gap. At stations where E2 is uncommon and you wish to draw attention to its presence, the best way is to describe h'F by -H, meaning value may be affected by stratification. Note: foE2, h'E2, have always been optional parameters and very few stations record them. When they are not recorded there is no way of showing the gap between foE and fminF. These points have been discussed in the High Latitude Supplement with examples showing interesting scientific points.

Similar remarks apply to the case where there is a perturbation of the F trace at frequencies below foF1. This has been given the nomenclature foF0.5. h’F0.5 is, usually numerically equal to h'F but occasionally is greater than h'F when the retardation below it is large. These parameters are useful to those studying TIDs in detail but not as statistics. Scientists often look at our Bulletin so as to use the same nomenclature as others hence we define many parameters which are not used in the standard international interchange.

dfS, fmI. These are again optional parameters which have been used for research by individual scientists but have never gained wide acceptance. We have to define them so that users know what they mean and so that scientists are given some guidance on possibly useful parameters. The most useful data are given by the foF2 and fxI tables which is why nearly all stations produce both.

Tabulation in trough conditions

Where trough conditions are found on most nights the most satisfactory solution is to tabulate the trough and ridge data separately. In practice, however, almost the same result can be obtained by tabulating foF2 and fxI and this is the practice at most stations. Difficulties are mainly found in the median value tables. It is impossible for a single median to represent a bimodal distribution of values as one has when some values of foF2 are trough, some ridge. Thus anomalies appear in the medians with values jumping between low and high values depending on count and which days contributed to the median.

The rule is that we always record as foF2 the critical frequency of the structure which is most nearly overhead.

In practice this is usually that for the higher trace with the lower critical frequency. When the ridge moves overhead, the spread polar spur trace usually clears up and shows signs of both o- and x— mode traces. These are not seen while it is oblique. If both are present and the spur trace shows two components it is the more nearly overhead and should be tabulated as foF2. This change often occurs very quickly so there is little value in spending much time on the borderline case.

(vi) Changes in scaling rules.

To help form a consensus on INAG policy for changes in rules all interested are invited to contribute short articles. In practice, of course, every station is entitled to accept or reject any changes, but it is advantageous for the community as a whole to recommend actions which are most generally acceptable. We have given much space to those who want a change. Here is a note giving some of the opposition views in more detail:

VI. The Effects of changes to the Scaling Rules for Ionospheric Characteristics

by A. S. Rodger, British Antarctic Survey

Natural Environment Research Council
Madingley Road, Cambridge, CB3 DET, U.K.

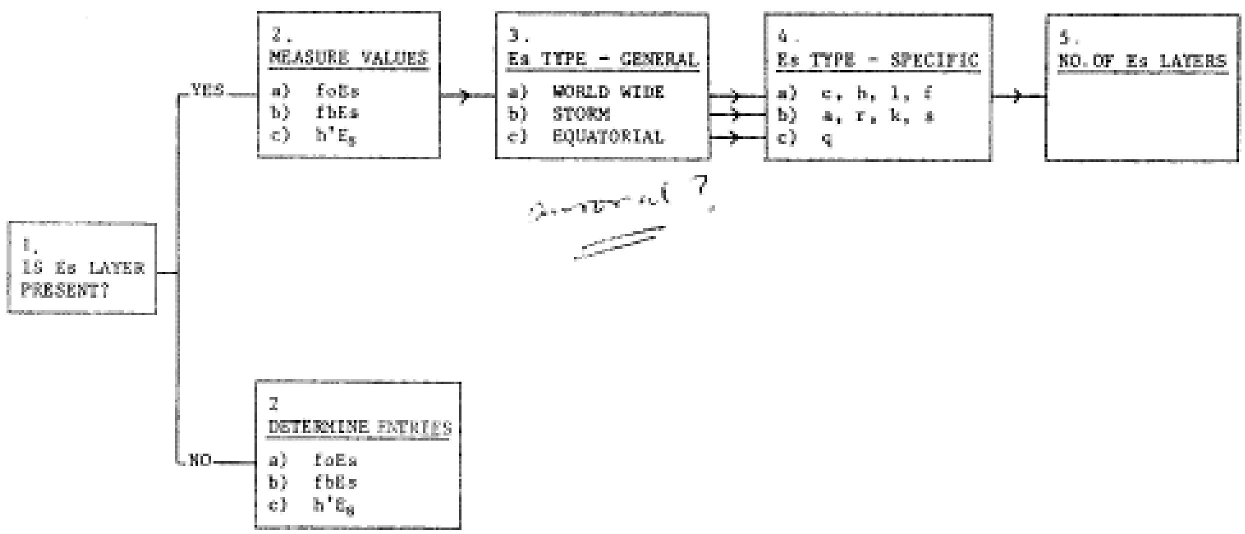
The rules for ionogram interpretation and reduction have gradually evolved since regular soundings of the ionosphere began over 50 years ago. During this period, changes to the rules have been made following a consensus of opinion arrived at through discussion in the INAG Bulletins, and at meetings of INAG and its predecessor the World Wide Soundings Committee. This gradual process has led to a system of ionogram analysis which most people in the VI network would consider satisfactory.

In nearly all INAG Bulletins, there are discussions and recommendations for changes and amendments to the existing rules The reasons proposed for these alterations are usually argued forcibly and well. Often when each change is considered in isolation, the case appears most compelling. However, the underlying philosophy behind the changes is seldom raised and the repercussions of such changes are seldom discussed fully. Some of these points are considered briefly below.

There appears to be two main reasons why changes in ionogram interpretation rules are suggested. The first arises because particular phenomena are of sufficient worldwide interest and importance, their occurrence should be monitored and recorded. The use of the letter Y to indicate the presence of lacuna is an example of a recent rule change to describe a phenomenon of scientific interest. The optional Spread—F scaling rules were adopted for more practical reasons — the importance of irregularities and spurs for radio wave propagation and communication. These types of change usually increase the complexity of ionogram interpretation and expand the detailed knowledge which the ionogram scalers must have at their fingertips. A direct consequence of these changes is that ionogram training requirements are increased and more highly qualified people are needed to carry out the scaling.

The second class of changes is in direct contrast to those described above and are intended to simplify the rules and reduce the time necessary for training. For example, rules which were designed to identify phenomena which are no longer considered important. The proposed changes to the rules on Es typing and the removal of M and T as qualifying and descriptive letters are good examples. However, most simplifications to the rules do not significantly reduce the time required to complete analysis. Figure 1 shows the procedures for scaling Es parameters. The only effect which the proposed rule changes for Es typing will have is to reduce the options in section 4(a) from four to one. Close scrutiny of the Es layer is required to complete sections 1—3 in the diagram, consequently, the typing of the Es layer is a relatively small step in the analysis process.

Fig. 1. Scaling Procedure for Es Parameters



A major problem which arises from any rule change is the practical one of incorporating them completely - into the various handbooks (UAG—10, UAG—23, UAG—23A and UAG-50), training manuals and computer programs. Again, using current proposals as examples, the Es typing proposals will require a complete revision of Chapter 4 of UAG-23, whereas the removal of letters M and T will mainly affect Chapters 2, 3 and 8. Both alternatives would then require incorporating into the indexes in INAG—30. Further to this, any changes require translation which can cause considerable delay in their implementation. UAG—23 now appears in at least six languages. Also, misunderstanding in the meaning of changes can arise in translation, as this is often carried out by non-specialist in ionospherics. Many groups now supplement the information in the handbooks with training aids and manuals developed for local use. These, too, require modifications when rule changes occur.

Finally, but by no means least, there are the large number of computer programs which include ionospheric scaling rules in some form. These range from the simple microprocessor systems, which check ionospheric characteristics for accuracy and consistency during scaling, to the more sophisticated programs, which evaluate medians, draw f—plots and determine electron density profiles.

Consequently, even superficially small changes to scaling practices can have very significant practical repercussions and require many workers to spend considerable time and effort in their implementation.

The compatibility and reliability of ionospheric data are appreciably reduced by changes to the rules, thus reducing their value to the data user community. There is likely to be a period immediately after changes are implemented during which the number of scaling errors is increased until complete familiarity with the changes is achieved. Each ionospheric group implements the changes to the rules at varying times, and, as a result, compatibility of the data from different observatories can take a number of years to be re-established. Changes to the scaling procedures can lead to difficulties in the determination of long— term trends, even when using data from only one station. Long series of data are essential to investigate changes such as those resulting from the continual drifting of the magnetic poles long term changes in the atmosphere or Sun, or in the intercomparison of ionospheric characteristics from different 22 year solar cycles (see INAG 27, p25) e.g. for updating CCIR prediction maps.

Optional scaling rules can cause even greater problems in data consistency, particularly if the data are not accompanied by a statement detailing the exact rules applicable.

All rule changes have appreciable effects on ionogram scalers, those involved with training and the scientific users of the data. Therefore, it is suggested that many proposed rule changes are not of sufficient importance to warrant the extensive effort necessary to implement them satisfactorily. A period of consolidation of the present rules is recommended at this time before the inevitable changes which will be necessary to accommodate ionosondes which record data digitally.

VII. URSI WORKING GROUP G10

INTERNATIONAL DIGITAL IONSONDE GROUP

BULLETIN NUMBER 2

by: J. R. Dudeney

Chairman, IDIG, British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 OET, England.

Introductory Comments

This bulletin reports on the activities of IDIG over the past year or so, and looks forward to the URSI general Assembly, which is scheduled for 10—19 August, 1981 in Washington D.C. The bulletin poses some questions about whether and how IDIG should continue after the General Assembly; it is *important* that *you* respond so that your Chairman has a clear brief of your wishes before the Assembly.

2. Recent IDIG Activities

(i) Business Meeting Held at the IUGG General Assembly, Canberra

An informal business meeting of IDIG was held in conjunction with the IUGG General Assembly, Canberra on the morning of December 12. It formed part of the program of IAGA and we are very grateful to Dr. Fukushima, Secretary General of IAGA, for fitting us into a tight schedule and for making the local arrangements. The meeting was attended by about 30 people. The agenda was as follows:

1. Chairman’s report on group activities
2. Status reports from participants
3. Activities of the group up to next URSI
   - (i) information exchange
   - (ii) data exchange and archiving
   - (iii) scaling practices

(iv) scientific meetings

4. Any other business

5. Poster session.

The Chairman's report concerned the material presented in IDIG bulletin number 1. No further comment is necessary here.

Several very interesting status reports were given by participants, Dr. Hunsucker from the University of Alaska took the trouble to prepare a written report (appendix 1) on the status and plans for his digital sounder. Mr. Kelly from KEL Aerospace reported on the development of a remote access system based on an IPS—42 sounder, which allowed several Australian users to acquire ionosonde data at their home bases on request. Dr. Shirochkov reported on developments in the USSR. There are two separate sounder developments; firstly, a research type sounder known as BASIS, and secondly a simpler expedition" sounder. The research sounder is either already operational at a number of centres, or about to be made so. The status of the "expedition" sounder is less clear. *(Chairman's note: please let as have any further information that is available on these developments).*

The Chairman raised the general question of whether participants felt IDIG was fulfilling a need and in what ways its activities should be directed. There was some discussion on these topics, but no clear conclusions were reached on future directions. However, the Chairman's suggestion of holding a scientific meeting at the next General Assembly of URSI was greeted with enthusiasm; and as you should be aware, action has been taken on this.

The meeting was closed by a poster session of five papers provided by IDIG Co-Vice Chairman, Klaus Bibl and his co-worker, Bodo Reinisch. The titles were:

"Digital Spacecraft Ionosondes" by Bibl

"Separation of Ionospheric Echos by Polarization, Incidence Angle and Doppler Shift" by Bibl

"Ionosonde Data Postprocessing" by Reinisch.

"Remote Transfer of Digital Ionograms in Real—Time" by Reinisch and Bibl

"Amplitude and Phase Ionograms" by Bibl

These papers were well received and appreciated by all who attended. A considerable number of preprints were available and were circulated; however, if anybody would like further information I am sure that Klaus and Bodo will be pleased to provide it (write to Dr. K. Bibl, Center for Atmospheric Research, University of Lowell, Lowe2l , Massachusetts 01854, U.S.A.). The inclusion of a poster session was a novel and interesting departure, which we should bear in mind at future suitable business meetings.

(ii) <u>IDIG Business Meeting Quebec, June 4, 1980</u>

Mr. *3.* W. Wright, Co—Vice Chairman of IDIG organized a further business meeting of IDIG, taking advantage of the North American Radio Science Meeting held in Quebec in early June 1980. This meeting was attended by 10 people from North America, Australia and Belgium. At this meeting the dominant topic of discussion was the problem of archiving digital sounder data. Bill Wright has provided the following summary of this discussion:

> "Buchau and Conkright reported that a large number of Digisonde tapes have been "dumped' on the WOC, clearly raising a problem of storage and retrieval for which they are not well prepared. We discussed, but did not resolve, the issue of retaining "raw" data versus reduced data only. Wright expressed the view that the WDCs should refuse raw data, and archive only what has been (reliably?) reduced to geophysical parameters. Wright asked how the meteorological services cope with their immense data flow.., that might provide a prototype. Reinisch noted that improvements in storage media may overtake the emergency of problems arising from the retention of 'too much" raw data. Wright questioned whether the problem was really one for IDIG (at least yet), since most of the digital ionosondes around are research instruments, and most of those will run non— systematically (both in terms of schedule and in terms of recording modes and formats). It seemed to him unlikely that vast amounts of data would descend on the WDCs, especially if the "no raw data" rule were applied."

This is clearly a very important matter which should be discussed both in IDIG and INAG. *Please let me have your views.*

3. <u>Standardization of Notation in Digital Sounding</u>

Bill Wright has raised some very interesting questions regarding the need for standardization in the notation employed for frequently used parameters (see his letter, appendix 2). The important /points here are to have a standard notation, representative of a particular definition of a variable, cast in a form that translates directly from written text to computer programmes. I believe Bill has raised an important point here, and one in which IDIG should give a lead. I suggest that we establish a small working party whose brief will be to devise a suitable set of notations which, after due discussion, can be given the formal blessing of URSI. *Please let me have your views on this topic as soon as possible.*

4. '<u>Aeronomic Studies Using Digital Ionospheric Sounders</u>'

Following on from the Canberra IDIG meeting your Chairman has organized, in conjunction with Dr. Hultqvist (Chairman, Commission G of URSI), a half-day scientific meeting with the above title as part of the URSI General Assembly in Washington D.C. This will be held on Thursday 13 August 1981 in the morning. The session will consist of one invited review paper, to be given by Professor T. B. Jones of Leicester University, U.K., and about six or seven contributed papers. An invitation to contribute has been circulated, and so far the response has been very good. I believe we will be able to put together a stimulating half—day session. Professor Sir Granville Beynon, Editor—in—Chief of the Journal of Atmospheric and Terrestrial physics, has offered his journal for publication of papers presented in Commission G. This should be an added incentive to produce first-class presentations.

5. Future of IDIG After The Next General Assembly

I do not believe that URSI Working Groups should have an inalienable right to existence independent of their function. They must be serving a useful purpose in the most effective manner. Thus, it is proper that the function of IDIG, and the effectiveness with which that function has been fulfilled, be reviewed at each URSI General Assembly. *It is for you, the interested scientists to make your views known both before and during the forthcoming Assembly.*

In my view, IDIG has served a useful general purpose in providing a channel to bring interested workers together, and to keep them informed of developments around the world. It has also served the specific purpose of providing the catalyst for organizing an international symposium. However, these are not sufficient reasons in themselves for continuing its existence. We must identify specific tasks which have an 'end product'; as well as just acting as a communications channel. Bill Wright has identified one such task (section 3). It is also clear that data interchange and archiving pose problems which may be appropriate as IDIG topics.
I would like to hear your views!

At present, this bulletin has a very restricted purpose. However, it could be developed along the lines of the INAG Bulletin to contain contributed articles. If this was done, we might need to seek financial support from URSI towards production costs. On the other hand, we could make more use of the INAG bulletin if Dr. Piggott (Chairman, INAG) was agreeable.

At the risk of repeating myself:- *let me have your views on, if, and how IDIG should continue.* Based on your responses, I will put together an agenda for an IDIG business meeting to be held in Washington.

6. Current Status of Digital Sounders

I would like to present at URSI a complete and up—to—date picture of the current status of digital sounders around the globe. Please *let me have details of your current equipment, location(s) and operating schedules,* current to the end of 1980.

Appendix 1

Brief Report For IDIG From Professor R. Hunsucker

An Advanced Ionospheric Sounder" (AIS) designed and built by the NOAA SEL Labs/Boulder, Colorado, is scheduled for installation near Fairbanks, Alaska in spring or summer 1980. It will be located at the Cleary field site, 24 miles North of Fairbanks just off the Steese Highway at a geomagnetic North latitude of 64.8°, Dip= 76.4°, L= 5.7 and a geographic West longitude of 147.3° in the (-10) time zone.

The site for the AIS consists of 40 acres situated on mining tailings at the confluence of Cleary and Chatham creeks near the location of the abandoned mining town of Cleary, Alaska. The AIS equipment will be located in a 40' x 8' x 8' insulated, heated trailer. A small building nearby houses two 5kW AC diesel generators for standby power. Commercial power lines have been contracted for and 200 VAC, 3 phase power should be at the site by spring 1980. A two—bay log-periodic antenna (designed by NOAA labs) has been constructed on four 120' telephone poles, in a square 300' on a side at the transmitter antenna site approximately 1000' from the AIS trailer connected with low loss "foam dielectric" line. An array of four 18' dipoles in a square 200' on a side comprises the receiving antenna array connected by buried low—loss coaxial cable approximately 100' to the AIS trailer.

Another 40 acres was cleared and levelled in September 1979 for a partial reflection antenna array to operated at a frequency near 5MHz in conjunction with the AIS system under the direction of Dr. Gene Adams at NOAA/Boulder. This 0—region aeronomy facility will also be operated cooperatively with the NOAA MST radar about 4km North of Cleary.

The Cleary AIS and partial reflection facility is near several other aeronomy facilities as shown in the Table:

Facility	Operated By	Distance From Cleary (km)	Remarks
Chatanika Radar (Incoherent Scatter)	SRI International	~ 4 km	Until ~ summer 1982
Poker Flat Rocket Facility Poker Flat Spectrophoto-metric Facility	Geophysical Institute	~ 5 km	Ongoing Program
NOAA MST Radar	NOAA	~ 7 km	Ongoing Program
Sheep Creek Ionosonde	Geophysical Institute	~ 30 km	Ongoing Program

All earthwork, levelling, road construction, erection of transmitting poles, trailer locating and auxilliary power installation was completed by fall 1978 and commercial power should be installed and the entire facility activated in summer 1980.

Geophysical Institute personnel have attended several training and information sessions on the AIS system at the Boulder labs during 1978 and 1979. We also plan close cooperation with Utah State University personnel who are operating a NOAA AIS at Logan, Utah and who utilise a DEC computer system similar to ours for data analysis.

Co-principal investigators for the Cleary AIS facility are Dr. Gene Adams of NOAA and Dr. Robert Hunsucker of the Geophysical Institute. Funding is provided by NSF through NOAA.

(i) INAG Chairman's note on IDIG Bulletin 2:

It is INAG policy to publish bulletins from any URSI Working Group whose output is of interest to the VI network and scientists who use its data.

As the amount of data available increases, the importance of handling it by computer techniques also increases. Hence the current interest in data entry systems, designed to minimize the manual handling of data and to put data into computer compatible forms at the earliest possible stage. Inherently digital ionosondes need no interface, but in practice useful accurate data are best obtained by combining digital and manual techniques. The human eye is much better at pattern recognition and identifying required parameters in the presence of less wanted data than is even a complex computer program. Thus the provision of digital equipment simplifies many interpretation problems and can improve numerical accuracy but does not solve these problems fully. Many VI groups, and aeronomical scientists, do not realize the value of ionosonde data as a method of complementing results obtained using Incoherent Scatter equipments. These are expensive to build and operate and produce so much data that the limited number of analysis staff available can only evaluate data for a few days per month. Standard ionosondes can complement these samples. Initially it is necessary to identify characteristic changes in the ionograms which correspond to specific phenomena seen on the incoherent scatter, and then looking for similar changes at other stations. It seems probable that similar problems will arise in the use of modern computer controlled advanced ionospheric sounders. In both cases, the changes with latitude and longitude can often be studied effectively by combining standard ionosonde data with that obtained by the more complex equipments.

Points for INAG discussion

Data to be circulated through WDCs

IDIG, section 2(ii), has invited INAG views on this problem. Should IDIG be requested to include any or all of the INAG parameters in its circulated data? What new parameters would you like to have available from the relatively limited net of digital ionosondes? *Please make your views known to the Chairman or at Washington (URSI) or Edinburgh (IAGA).*

(ii) Comments on IDIG Bulletin appendix 2. Proposed for a revised set of symbols and definitions

Mr. Bill Wright has suggested that it is timely to produce a standard set of symbols and definitions for use with digital ionosondes. In so far as these would be used primarily for research purposes at individual stations or for interchange of data with other digital ionosondes they would primarily be the responsibility of IDIG. Where, however, the data are likely to be widely used outside this group, or in conjunction with data from standard ionosondes, it is important that the proposals should be, as far as possible, consistent with accepted practice. This may involve some logical inconsistencies which should probably be accepted in the interests of the many users who only have a superficial knowledge of the technical problems. It is surprisingly difficult to get aeronomical scientists to use ionosonde data when this could contribute significantly to their work. We must not increase their apparent difficulties by a more complex or, worse, new set of names for existing parameters.

In order to stimulate discussion on Mr. Wright's proposals your Chairman has prepared the following critical comments. He accepts that Mr. Wright's proposals are not worked out but feels that now is the time to point out some of the points which will need discussion in a considered set of proposals.

Appendix 2

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL RESEARCH LABORATORIES
Boulder, Colorado 80303

August .11, 1980 R43/JW

Dr. J. R. Dudeney
Natural Environment Research Council
British Antarctic Survey
Madingley Road, Cambridge CB3 OET
England

Dear John,

Here are some small but useful questions which IDIG might resolve:

1) Can we advise standard notations for variables of frequent use (group height, amplitude, phase, doppler velocity, etc.)?

2) Can we write standard definitions, so, for example, we don't confuse range, path, height, when we need to distinguish then?

3) Should we advocate notations which are computer-compatible, for the sake of easy code-reading (e.g., avoid subscripts, superscripts, greek and other unavailable symbols)?

I find, in my own work, that I am at least <u>wishing</u> for consistency on those points, even if I am practicing it only imperfectly. Software is so important now that it is a real annoyance to carry notations (such as h*, h', foF2) from conversations, into computer code, out again, and into publication —— all necessitating changes of style and notation at every turn. On the other hand, there are not enough single ASCII characters to go around, so the only options are multiple—character notations. Furthermore, whore computer—driven print or microfilm are to be published directly (a growing trend) we are simply forced to use notations which the machines can emit. Furthermore, consistent notation would help in exchanging software.

I am already aware that conventional referees and editors will resist publishing what I here propose (or anything like it) , but I feel we must press the case. It is early enough to consider alternatives, but for the sake of provoking discussion, here are some notations I am using now:

Not a lot of thought has gone into this (which shows, I'm sure), and I have a very low vested interest in many of the choices above. I am also disturbed by inconsistencies (e.g. the use of X, Y spatially, and for quadrature components) . If we can just agree that these are the goals to be reached (questions 1, 2, 3), we will have made a beginning, and IDIG will have another task to pursue.

Sincerely,

J. W. Wright

Symbol	Definition
AL	echo peak log amplitude (modulus)
AX, AY	complex amplitude components
AL1, AL2, etc.	AL at antennas 1, 2, etc.
AX1, AX2, etc.	etc.
etc.	
DF	frequency difference (MHz)
DX, DY	inter-antenna spacings in our 4-antenna array (meters)
F	radio frequency (MHz)
FP	plasma frequency (MHz)
FO, FX	frequency of discriminated echoes
FPF2, FPE, FPES	maximum plasma frequencies
etc.	
P	echo phase (degrees, radians)
P1, P2, etc.	P at antennas 1, 2, etc.
PX, PY	phase differences along X, Y
PF	phase difference due to DF
PP	orthogonal-antenna (polarization difference)
RG	group range
RGX, RGY	horizontal components (km)
RGZ	vertical component (km)
RS	phase range increment (km or m)
TOA	envelope time-of-arrival (the old h’)
etc	

(I) Maximum plasma frequencies

The maximum plasma frequency is numerically equal to the o—mode critical frequency foF2, foF1, foE, etc. (in computer form FOF2, FOF1, FOE, etc.) These are well understood by all users. Hence why invent a new symbol? Any distinction is not important in data tabulation or exchange and a special symbol can be invented when needed for scientific papers. Why change to FPF2, FPF1, FPE, etc?

(ii) Group ranges and virtual heights.

Complex digital ionosondes can measure vertical heights in two different ways which do not necessarily give identical answers and, in general, have different accuracies and sources of error. They can also distinguish between overhead and oblique traces and will probably need symbols to represent the data from all these cases.

With other ionosondes, virtual height is usually measured using the pulse shape, frequently changed by differentiation and subject to error determined by ionosonde design and method of operation. The letter symbols h'I have been widely used to denote range at vertical and oblique incidence, with some inconsistencies, e.g. h'I is always an oblique measurement tabulated, for convenience, as if it were vertical.

The existing convention is that h’ is used for both vertical and oblique measurements, since obliquity cannot always be established. When several traces are present, the one most nearly overhead is identified with the aid of rules. This idea has much practical importance.

We need as complete a set of data as possible because gaps in data usually modify medians more than any errors in measurement or interpretation. This need should be remembered.

While replacing h'I by R has the logical advantage of removing the difficulty of identifying vertical and oblique traces, the disadvantages of a change from a well understood and popular convention appear to be decisive, as they were in the past.

The complex digital ionosondes can measure phase height, virtual height by delay time and virtual height by stationary phase and can deduce true height by several techniques. This suggests choosing complex letter symbols for these parameters. As at present upper case letters are preferable for computer use though mixed lower case is more convenient for users.

A possible set could be:

Virtual height by delay time

h'	HD or HA	(H dash or H apparent)
h's	HS	(measured by stationary phase)
hp	HP	(phase height with ambiquity nπ)
ht	HT	(true height by preferred method)
	HTX	(X arbitrary letter denoting a non-preferred method)

For oblique traces, the corresponding symbols could be LD, LA, LS, LP, LT.

(ii) Modes.

Since complex digital ionosondes can readily separate o-, x— and z—mode reflections, it is likely that they will measure these separately. Thus OXY should be reserved for identifying the magnetoionic components. It might be better to use other letters for identifying antennas e.g. JK and MN. Otherwise numbers could be used.

(iii) Consistency and accuracy

A parameters: is there a natural level from which the amplitudes should be measured?

(iv) Other letter symbols

P is suggested for plasma, phase and polarization. This can cause confusion.

D is sometimes used for difference but not always e.g. PX, PY, PF. Why not use D everywhere?

(v) T.O.A.

Time of arrival is a queer parameter essentially identical to P' which has long been obsolete. It is unlikely to gain any support. h' H' or alternatives appear much better.

(vi) General

Mr. Wright's point on the need for consistency and simplicity is real but simple is not always logical. Probably most specialized digital letter symbols will be restricted in use to those directly involved. Those chosen for wider use should as far as possible, be consistent with existing nomenclature so as to be as easy as possible for scientists who are not specialists. At present the circulation of all digital data appears likely to be counter productive. It is unlikely that the raw data from different ionosondes will be directly compatible. Thus those wishing to use the full data from a given station will probably always need considerable guidance on data format, meaning, and interpretation and should apply direct to the station.

At present we have little or no experience in selecting synoptic parameters which are likely to be useful in the future from complex digital equipments. We need a period of experiment at, preferably, more that one station to select these parameters. At present the nearest guide is the N(h) recommendations in the Guide to International Interchange through WDC's; Programme B.1.f on p. 23 of 1973 edition.

It is important that I. D. I. G. and INAG have the views of both users and producers of VI data on these points particularly on parameters which will be needed in the future. It may be useful to note that, in the past, the most useful synoptic parameters have been simple to visualize, easy to produce and reasonably representative of physical phenomena. If the essential features of a phenomenon change in space and time, and parameters can be found which are economical to produce and circulate such parameters are potential candidates for synoptic applications.

VIII. URSI General Assembly Washington

PROVISIONAL PROGRAMME

Aeronomic Studies Using Digital Ionospheric Sounders'

Thursday 13th August 1981

0830 to 1200

0830 Invited Review: The Role of Modern Ionosondes in Ionospheric Physics
T. B. Jones, Department of Physics, Leicester University. Leicester, LEI 7RH, U.K.

0900 An Advanced Mission to Map the Worldwide Topside Ionosphere Using a Pulsed Doppler Sounder.
H. R. Mathwich, D. Aubert, A. Hartz, K. Bibl and Lt. D. Lewis.
Astro-Electronics Division P0 Box 300, Princeton, New Jersey 08540.

0920 Automatic Electron Density Profiles From Digital Topside and Bottomside Ionograms.
B. W. Reinisch, Huang Xueqin, Jane Tang, University of Lowell Centre for Atmospheric Research, 450 Aikon Street, Lowell, Mass 01854.

0935 Digital Sounding: The FMCW Alternative,
A. W. V. Poole, Antarctic Research Group, Department of Physics and Electronics, Rhodes University. Grahamstown 6140, South Africa.

0950 A Discussion of the Ionosonde at the Arecibo Observatory and Comparisons With Data From Incoherent Scatter Radar.
C. A. Gonzales, K. A. Behnke and R. F. Woodman, Arecibo Observatory, Box 995, Arecibo, Puerto Rico 00612.

1005 COFFEE BREAK

1020 Early Results With the New NOAA Ionosonde.
A. K. Paul, NOAA/ERL/SEL, Boulder, Colorado 80303.

1035 Data Processing for the Dynasonde: Methods for Polarization Discrimination, Doppler. Echo Location and Trace Identification.
J. W. Wright and H. L. V. Pitteway, NOAA/ERL/SEL, Boulder, Colorado 80303.

1055 Frequency — Time Trade-Offs in Ionospheric Sounding.
H. L. V. Pitteway, Department of Computer Science. Brunel University, Uxbridge, UB8 3PH, U.K.

1110 Digital Ionospheric Sounder Studies of Ionosphere Magnetosphere Coupling at Roberval Quebec.
C. C. Park and J. H. Doolittle, Radio Science Laboratory, Stanford University, Stanford, CA 94305.

1125 Studies of the High-Latitude Ionosphere at L = 4 and L = 5.6 Using the Digital H. F. Radar.
F. T. Berkey, G. S. Stiles, 0. K. Doupnik, Centre for Atmospheric and Space Sciences, Utah State University. Logan, Utah, 84322.

1140 Towards a Global, Real-Time Ionospheric Monitoring System.
J. W. Wright and H. K. Paul. NOAA/ERL/SEL, Boulder, Colorado 80303.

IX. Japanese Training Handbook

The existence of a simplified training handbook, showing ionograms and interpretation, prepared in Japan was announced at the INAG meeting at Geneva. (INAG-32 p.5). In response to a request from the meeting that an excerpt be published in the INAG bulletin, Dr. Wakai, who has been acting as INAG member in Japan, has submitted the attached example. The volume was prepared by Mr. H. Ohyama, Director of the Wakkanai Radio Wave Observatory of the Radio Research Laboratories, Japan and is based on UAG-23.

We feel that the congratulations of INAG and the Network should be expressed to Mr. Ohyama. Dr. Wakai writes:

"If the INAG community would encourage the scheme, an English version, with some refinement, may be produced. In the original the ionograms are shown on a left hand page, line drawing and tabulation on right hand, followed by Japanese and English test."

Do you wish to have this publication, with an English translation, generally available? If so please let INAG know in time for a decision at Washington.

As Chairman, I feel that a full set of temperate latitude ionograms with line drawings, tabulations and notes would be invaluable even when your local ionosonde is different.

Additional notes could be contributed by the Chairman if the authors and users so desire. For example fbEs Figure 6, I concur with the interpretation of fbEs but would add "The absence of any M or N reflections makes it likely that this example was actually a meteor Es trace which could be ignored under the weak or transient echo rules. This is thus a good example of a trace which can be ignored." Perhaps the same ionograms could be used in the appropriate section - both interpretations are right.

Simplified Handbook for Ionogram Interpretation and Reduction
(Japanese Version)

This handbook is a sort of simplification of the URSI Handbook of Ionogram Interpretation and Reduction, second edition 1972, being prepared for the use by trainees to be engaged in the business of the ionogram scaling. This may be characterized by the following:

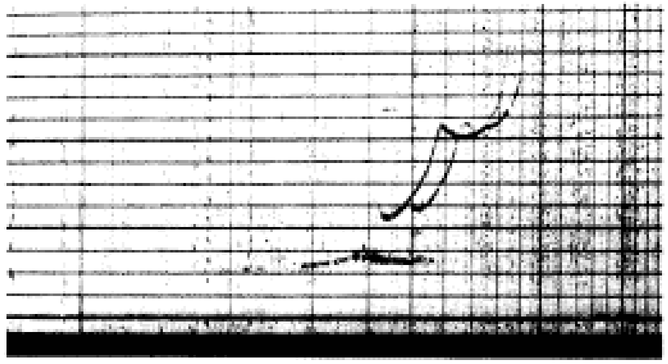
(1) This version is compressed down to roughly 100 pages, in contrast to the original Handbook (URSI 1972) of more than 300 pages.

(2) This handbook is completed as applicable to the mid-latitude ionograms which are commonly obtained at Japanese sounding stations.

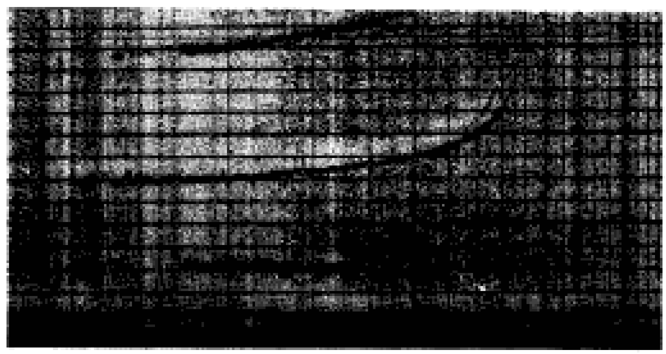
(3) It is compiled in the order of such ionospheric parameters as, fmin, foE, h'E, foEs, h'Es, type of Es, fbEs, foF1, h'F, h'F2, foF2, fxI, M(3000)F1 and M(3000)F2.

(4) This is composed on the cross-reference basis between the corresponding columns on left and right pages. In other words, the line drawings of the ionograms and scaled values on left side pages correspond to the descriptions of the reasons on scaling, notes and remarks on the right side pages.

N. Wakai
Japanese member of INAG
Planning and Support Division Radio
Research Laboratories



Station: Wakkanai
Date: May 25, 1979
Time: 1145 (135°EMT)



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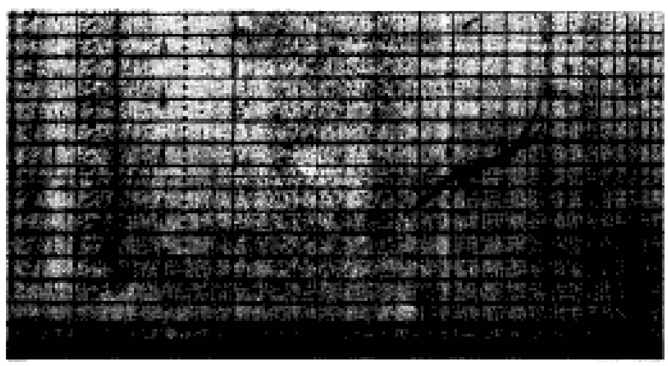
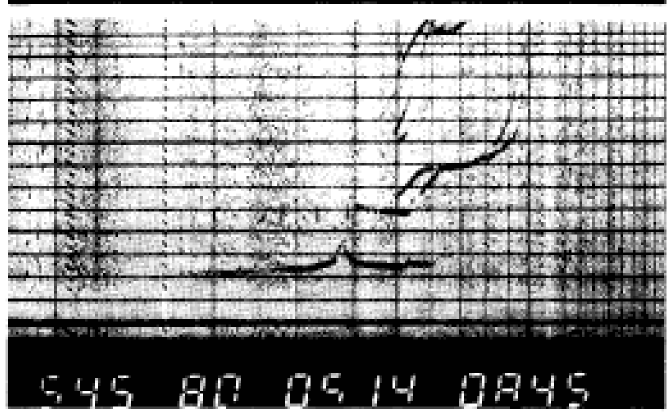
Date: May 19, 1980
Time: 0245 (135°EMT)



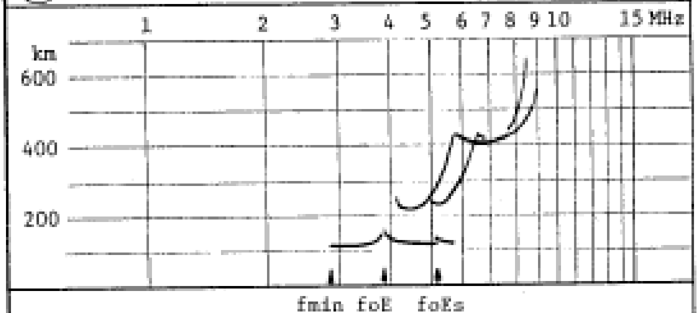
Station: Wakkanai
Date: May 8, 1980
Time: 1000 (135°EMT)



Station: Wakkanai
Date: May 14, 1980
Time: 0845 (135°EMT)

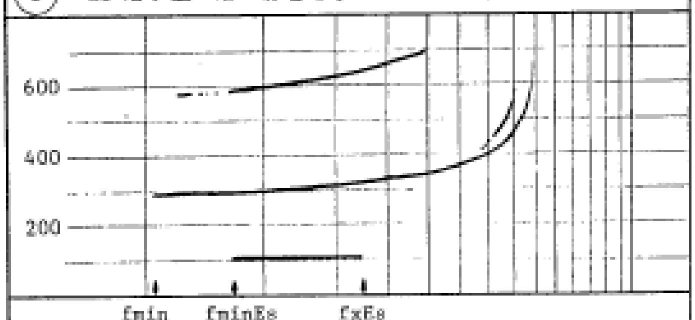
fbEs - 2

⑤ Es 層が上の層に影響を与えていない（昼間）



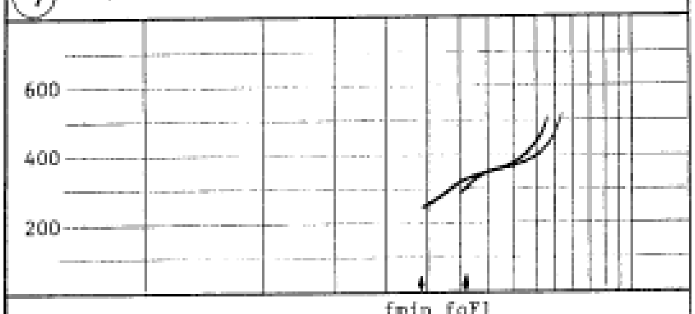
fmin	28
foE	390
h'E	110
foEs	51
h'Es	120
Es type	c1
fbEs	G
foF1	58
h'F	215
h'F2	400
foF2	84
M3000F2	-
fxI	-

⑥ Es 層が上の層に影響を与えていない（夜間）



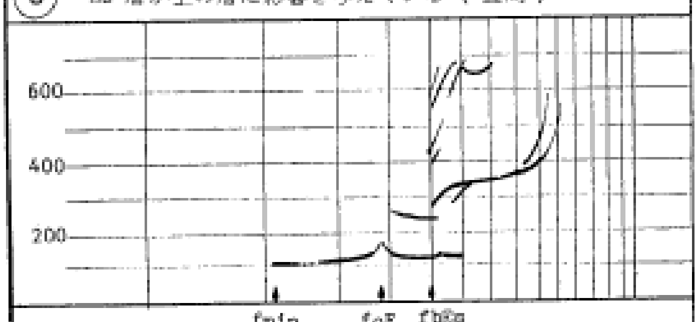
fmin	10
foE	-
h'E	-
foEs	29JA
h'Es	100
Es type	f1
fbEs	E
foF1	-
h'F	290
h'F2	-
foF2	81
M3000F2	-
fxI	88-X

⑦ トレースがイオノグラムの途中から出現している



fmin	49
foE	B
h'E	B
foEs	49EB
h'Es	B
Es type	-
fbEs	49EB
foF1	L
h'F	250EB
h'F2	330-L
foF2	96
M3000F2	-
fxI	-

⑧ Es 層が上の層に影響を与えている（昼間）



fmin	21
foE	280
h'E	100
foEs	53
h'Es	120
Es type	c2
fbEs	50
foF1	L
h'F	A
h'F2	340
foF2	94
M3000F2	-
fxI	-

fbEs - 2

⑤ 観測： foE は 3.90 MHz で c タイプ Es が観測される。F 層トレースの低周波数端（4.1 MHz）に遅延がみられる。また fmin が通常よりやや高い。

注釈： このイオノグラムのように、F 層トレースの下部が遅延を示している場合は、この層に対する c タイプ Es の影響は全くないと解釈できる。

fbEs ＝ G （より正確には fbEs ＝（foE）EG）

⑥ 観測： 夜間のイオノグラム。100 km の高さには f タイプ Es がみられる。F 層トレースは観測機の下限周波数付近から観測されている。 fmin ＝ 1.0

注釈： fmin Es（Es層トレースの最低周波数）と fmin F（F 層トレースの最低周波数）を比較し、両者が等しいか、または fmin Es が fmin F より大きい場合には Es 層の影響はないと解釈する。

fbEs ＝ E （記号 E は昼間に用いられる記号 G に相当する）

⑦ 観測： F 領域のトレースだけが 4.9 MHz から観測されている。 fmin ＝ 4.9

注釈： 前後のイオノグラムを参照してトレースが消えた原因を確める。この場合は SID（電離層急始じょう乱）による吸収（B）である。fbEs の値は、fmin の数値に限定記号 E（より小）と説明記号 B をつけて表す。

fbEs ＝ 49 EB

参考： 原因が吸収以外のときは説明記号を適当にかえて読み取る（たとえば、観測器の故障： C）。

⑧ 観測： 120 km 付近にある c タイプ Es は正常波成分、異常波成分に分れ、2回反射トレースもみられる。 foEs ＝ 5.3 fxEs ＝ 6.0 foF1 の値は 5.8 MHz 付近と推測される。

注釈： fmin F（5 MHz）は c タイプ Es の foEs より明らかに低い。したがって 5 MHz 以下の F1 層トレースは c タイプ Es によって遮へいされたと解釈する。

fbEs ＝ 50

$f_b Es$ - 2

5 foE is observed at 3.90 MHz with the c-type Es. The group retardation at the lower end of F trace is also observed at 4.1 MHz. f_{min} seems to be somewhat higher than the value usually expected.

Note: In the case where the lower end of F trace shows group retardation as seen in this example, it could be interpreted that the c-type Es never influence the upper layer.

$f_b E_s$ = G (more accurately $f_b E_s$ = (foE)EG)

6 Nighttime ionogram. The f-type E_s is observed at an altitude of 100 km. The F trace is observed from around the lower limit of ionosonde. f_{min} = 1.0

Note: In the case where $f_{min}E_s$(lowest frequency of Es trace) is equal to, or larger than $f_{min}F$ (lowest frequency of F trace), the interpretation that there is no influece of Es on the upper layer is correct.

$f_b E_s$ = E (symbol E corresponds to symbol G used in the daytime)

7 Only F trace is observed from 4.9 MHz. f_{min} = 4.9

Note: In cross-reference of ionograms before and after this ionogram, the reason why the lower trace disappeared should be confirmed. In fact, this example was obtained during the SID (Sudden Ionospheric Distrubances), when the absorption (B) increased. $f_b E_s$ should be represented by the value of f_{min} accompanying qualifying letter E and descriptive letter B, i.e.

$f_b E_s$ = 49 EB

Remark: When the disappearance of lower trace can not be ascribed to the absorption, some appropriate descriptive letters other than B should be attached (e.g. malfunction of ionosonde: C)

8 The ordinary and extraordinary traces of c-type E_s are observed at around 120 km.

foEs = 5.3 $f_x Es$ = 6.0 foF1 = 5.8 MHz

Note: $f_{min}F$ (5MHz) is clearly lower than foEs of c-type Es. Therefore, the lower portion of F1 trace below 5 MHz can be interpreted to be masked by c-type Es.

$f_b Es$ = 50

X. Handbooks of Ionograms

In addition to the Japanese Handbook referred to on p. 19 the Chairman has been informed:

(a) That a South American atlas of ionograms is being produced (reported by Dr. Giraldez).
(b) That I.P.S. Australia is producing a Handbook of Mawson (high latitude) ionograms.

XI. Ionospheric Vertical/Oblique Sounding Network in Japan*

N. Wakai
Japanese Member of INAG
Radio Research Laboratories, MOPT, Japan

If the radio emission from each ionospheric sounding station in a network is coordinated so as to be received in turn at the other individual stations in the network, the routine ionospheric sounding would be much more effective for applications to the real-time monitoring of propagation conditions.

Such a two-way sounding network is going to be established among five Japanese sounding stations, Wakkanai , Akita, Kokubunji , Yamagawa and Okinawa, for the purpose of short-term propagation prediction for HF telecommunication circuits. This will enable the ionosphere to be sampled at 25 different locations.

Some additional components have to be incorporated in the 9B-type ionosonde (standardized model installed at all Japanese sounding stations), in order to allow oblique incidence sounding in addition to the conventional ionosonde mode of operation.

Fig. 1 shows the various propagation paths between the ionospheric sounding stations, together with the corresponding path distances and mid-points of the paths (cross mark in the figure).

It is expected that when the network is operated on a routine basis, information about the ionosphere at the apexes of reflection (midpoint of paths) could be obtained in addition to those above the sounding stations.

Fig. 2 shows a coordinated schedule of transmission within two minutes to be centered at 0, 15, 30 and 45 minutes of each hour.

Each sounding station will be able to receive swept-frequency sounding signals from each of the five stations and issue short-term propagation predictions for use by local users as required. Furthermore, this network enables us to monitor not only the ionospheric and HF propagation conditions over the whole area of Japan, but also to provide useful means for predicting the interference of VHF signals (land mobile, FM and TV broadcasting) via the Es layer as well as the scintillation of satellite signals. For this application the whole of the data for both vertical and oblique sounding are collected and processed at a prediction center.

The development of an inexpensive receiving system which is capable of receiving the routine sounding signals is also important for making this network useful for public users.

* This project is under development at Ionospheric Radio Prediction Section headed by Dr. R. Maeda, Radio Wave Division, RRL. Any comments to this project are invited to be forwarded to Mr. T. Takeuchi.

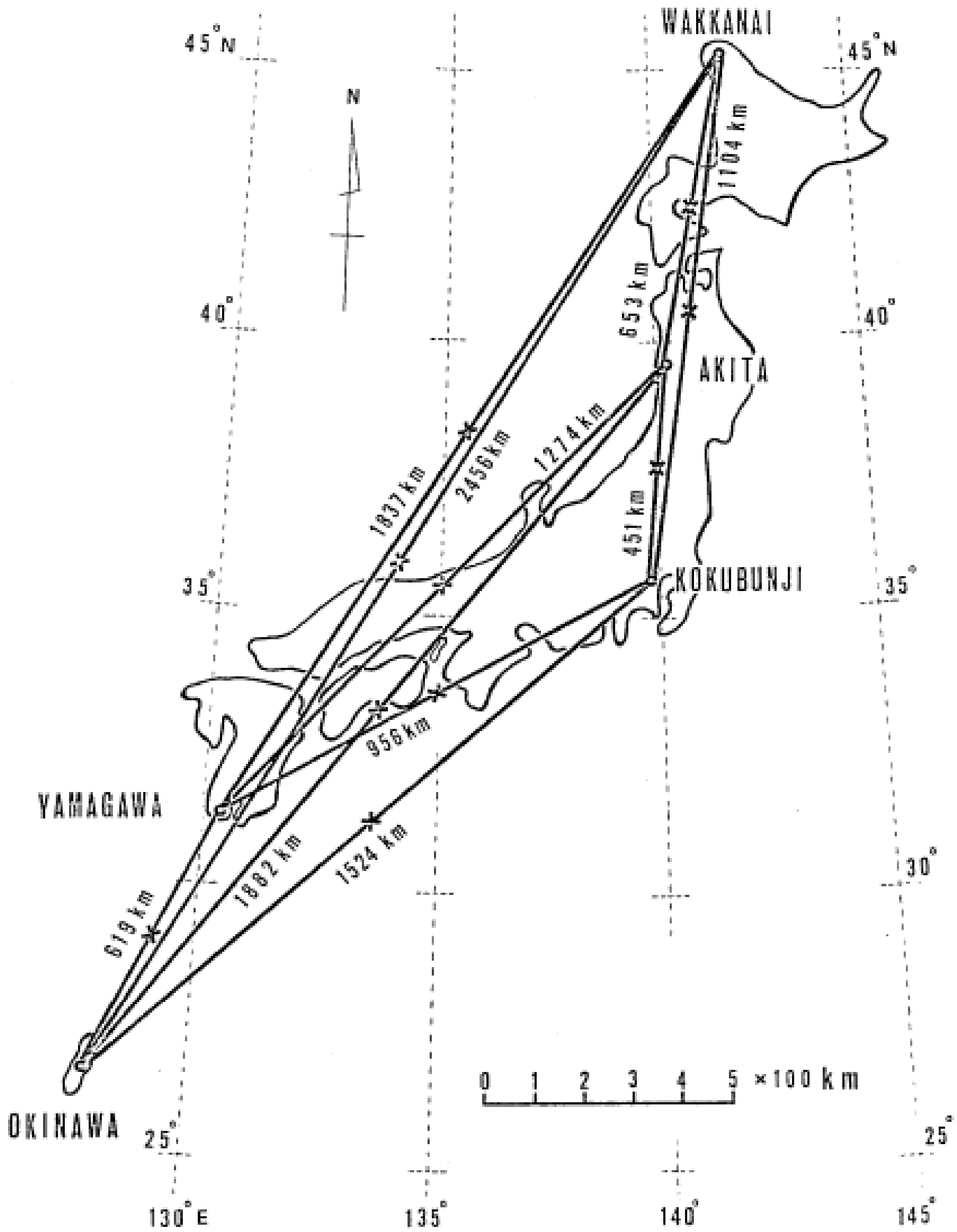


Fig. 1. Ionospheric vertical/oblique sounding network in Japan.

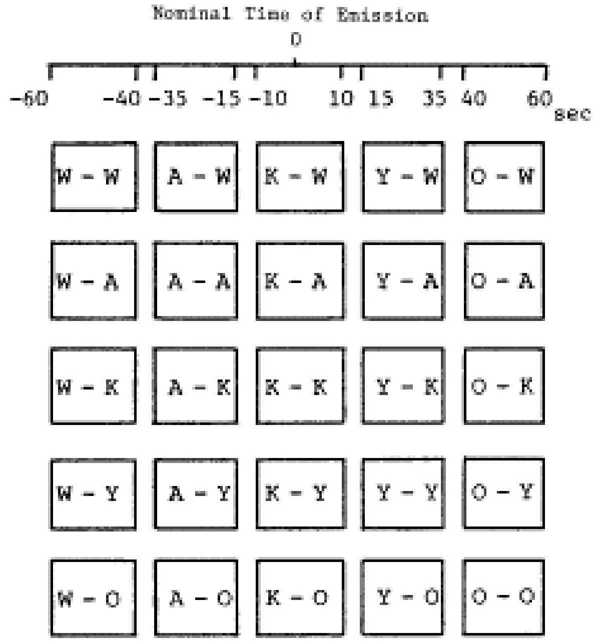


Fig. 2. Schedule of coordinated transmission.

(W—Wakkanai, A—Akita, K—Kokubunji,

Y—Yamagawa, and O—Okinawa)

XII. Ionogram Reduction System using a Digitizer connected to Computer

by: N. Wakai
Japanese Member of INAG
Radio Research Laboratories

Ionospheric sounding at vertical incidence is a widely used technique for obtaining basic information of the ionosphere. The extraction of ionospheric parameters from the ionograms is an indispensable but time-consuming and laborious work without which the ionospheric sounding itself would be meaningless.

The Radio Research Laboratories, as the organization in Japan responsible for performing routine sounding and ionospheric research, has been devoting effort in providing ionospheric data of good quality for more than 30 years. Several approaches have been proposed and tested so far for saving time and labor and speeding up the reduction of ionograms. None of them, however, has reached ultimate success owing to various kinds of limitations.

Under those circumstances, the development of a fully computerized reduction system was authorized as a research project in RRL in 1978.

At the same time, a computer-aided manual reduction system has also been proposed as one of promising systems which will be put into practice within a couple of years.

This report describes the outline of the latter reduction system developed at Ionospheric Radio Prediction Section, RRL, headed by Dr. R. Maeda in 1980.

This system is composed of the following components, as shown in the figure attached:

Film projector
Digitizer (HP 9874A): effective size of screen 435 x 315 mm
resolution 0.025 mm
Exclusive Computer (HP 9845B): Memory 56 kB
Character Display 24 line x 80 letters
Cassette Tape Recorder 217 kB
Thermal Printer 80 letters/line
Tape Puncher (FACIT 4070): 75 characters/sec

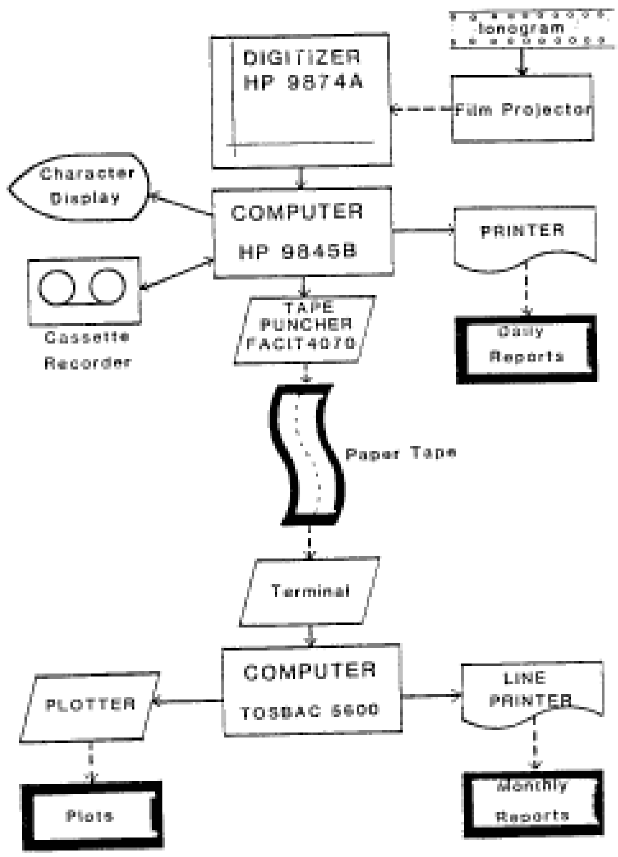
The output of the Tape Puncher is fed manually to the Tape Reader Terminal which is connected through the telephone line to the central Computer (TOSBAC 5600) system including Line Printer and Plotter.

The software for the ionogram reduction with digitizer is written in the BASIC language, consisting of the following programs; Coordinates calibration, Trace scaling, Parameter relation, Character display output, Cassette tape recorder input and output, Error detection and amendment, Daily report (Thermal printer output), and Tape puncher output.

The procedure to be followed by the scaler in the ionogram reduction on a routine basis is as follows:
A normal 35 mm film ionogram is loaded on the projector and reproduced in an enlarged size on the screen of the digitizer. Scale calibrations are made for the origin, logarithmic frequency on the abscissa and linear height range on the ordinate.

Ionospheric parameters are reduced from the ionogram with a stylus of the digitizer in accordance with the rules, accuracies and symbols as recommended by the URSI Handbook of Ionogram Interpretation and Reduction.

The reduction is performed in the form of conversation with the exclusive computer. The error detection and amendment are made for the reduced parameters which are recorded both in the character display and the cassette tape which is proofed against power breakdown. Then the paper tape and daily report are punched out of the tape puncher and the printer respectively, after the completion of ionogram reduction for a day.



This system is now operating satisfactorily for the reduction of ionograms obtained at Kokubunji and at Syowa Station in Antarctica.

Block diagram of Ionogram Reduction System

using a Digitizer

Note: *Any comments and questions are invited to be forwarded to Mr. Y. Kuratani who is wholly responsible for the development and operation of the system.*

XIII. Fiftieth Anniversary of first Synoptic Ionospheric Sequence

The first successful measurement in a regular program of ionospheric soundings at noon was made at Slough on Sunday 11 January 1931. Thus initiated the Slough Ionospheric Observatory which has continued to observe the ionosphere for over 50 years, the longest sequence in the world.

A group of about 24 ionospheric scientists met at the Appleton Laboratory on Sunday 11th January 1981 to drink wine, renew old acquaintances and to watch the noon ionogram being recorded. The archives were opened and many photos of early workers, equipment and data were on display. These first observations were made by the frequency change method using continuous wave transmissions. This gave very accurate measurements of virtual height but was very difficult to interpret when two or more reflections were present with similar amplitudes. The main interest was in the behavior of foE during the day, night time variations had been studied earlier. Owing to the absence of MF transmissions in those days, there was no difficulty in following foE down to 0.7MHz, except, of course, for interpretation when sporadic E was important.

Pulse h'f equipments (manual) were built at Slough for use in the Second Polar Year 1932-3 and one was deployed at Tromso— the first high latitude synoptic study (Appleton, Naismith and Ingram. Phil. Trans. 236 p. 191—259, 1937). This delayed the installation of a synoptic equipment at Slough where the first noon observations of foE, foF1, and foF2 were made on 23 Sept. 1932. This started the current sequence of synoptic measurements of all three layers at Slough.

Appleton was a great believer in the importance of making regular accurate measurements, initially concentrated at the equinoxes and solstices and on Wednesday. An inspection of the International Geophysical Calendar will show that this tradition has continued to this day — where effort is limited this is very efficient.

The early days were represented by Sir Granville Beynon, Dr. W. R. Piggott, Mr. J. A. Ratcliffe and Mr. A. F. Wilkins and the ionosonde was operated by Mr. K. Feldmisser. The Chairman of INAG was invited to comment on the ionogram which showed both sporadic E and M reflection traces, indicating slight tilts in the F layer.

The Fiftieth Anniversary of the establishment of the Slough Ionospheric Observatory was celebrated at the Appleton Laboratory, Slough on 12th January 1981 with a series of lectures under the Chairmanship of Prof. J. T. Houghton and Dr. J. W. King. Sir Granville Beynon gave a popular lecture on 'Fifty years of ionospheric sounding' in which he reviewed some of the highlights of the period and told stories about three of the early workers associated with Slough, Mr. Wallace Brown, a New Zealand marine radio operator who was Appleton's assistant in the 1920's and 1930's, Dr. W. R. Piggott and Sir Edward Appleton. The future of ionospheric and radio propagation research was then discussed by Dr. H. Rishbeth, Dr. W. R. Piggott, Mr. W. H. Bellchambers and Dr. W. C. Bain.

Although the Appleton Laboratory will be combined with the Rutherford Laboratory at Chilton, the ionosonde will probably continue at Slough. It is proposed to use a digital equipment when the Laboratory is closed so that the ionograms can be recorded in real time at Chilton and the data made available to operational users.

XIV. Deployment of Advanced Ionospheric Sounder at Halley, Coates Land, Antarctica

The Advanced Ionospheric Sounder (computer controlled digital ionosonde) belonging to the British Antarctic Survey has been deployed in an insulated, temperature controlled cabin and is well sprung to withstand the shocks and vibration of transport by ship and over uneven ice shelves. It has also been provided with a power supply adequate to operate a small observatory which is similarly mounted. The cabins are fixed to heavy sledges for Antarctic use and can be raised above the snow surface on four jackable logs. This is necessary as the snow surface at Halley rises by a meter or so every year and any building on the surface is rapidly drifted over.

Much preparatory work was necessary as Halley is on a floating ice shelf, but exceptionally bad weather prevented the arrival of the advance party until only three days before the arrival of the ship, RRS Bransfield.

The weather remained unseasonally bad, with high winds, but nevertheless the equipment was all successfully transferred to the sea ice and transported some three kilometers to Halley Base. Two 50m masts and numerous short masts were raised, ground mats and antennas erected and the whole equipment and power units tested. Despite high winds, which made outside work difficult, exhausting and sometimes dangerous, several days of test operation using the synoptic and research programs were successfully completed before the ship had to leave, 16 days later. In parallel, the normal relief of the Base was carried out in the same period, most Base members working in one or other of the 12-hour shifts. Normal scientific observations were also maintained in this period.

XV. Ionogram Sequence Showing Large Differences Between 0- and X-Mode Traces

by: S. M. Broom, British Antarctic Survey

The ionogram sequence in Figure 1 was recorded at South Georgia (54°S, 36°W) during the night of 30 July 1971. The unusual feature of this sequence is the marked difference between o- and x—mode reflections, indicating the presence of considerable gradients in the magnetic meridian.

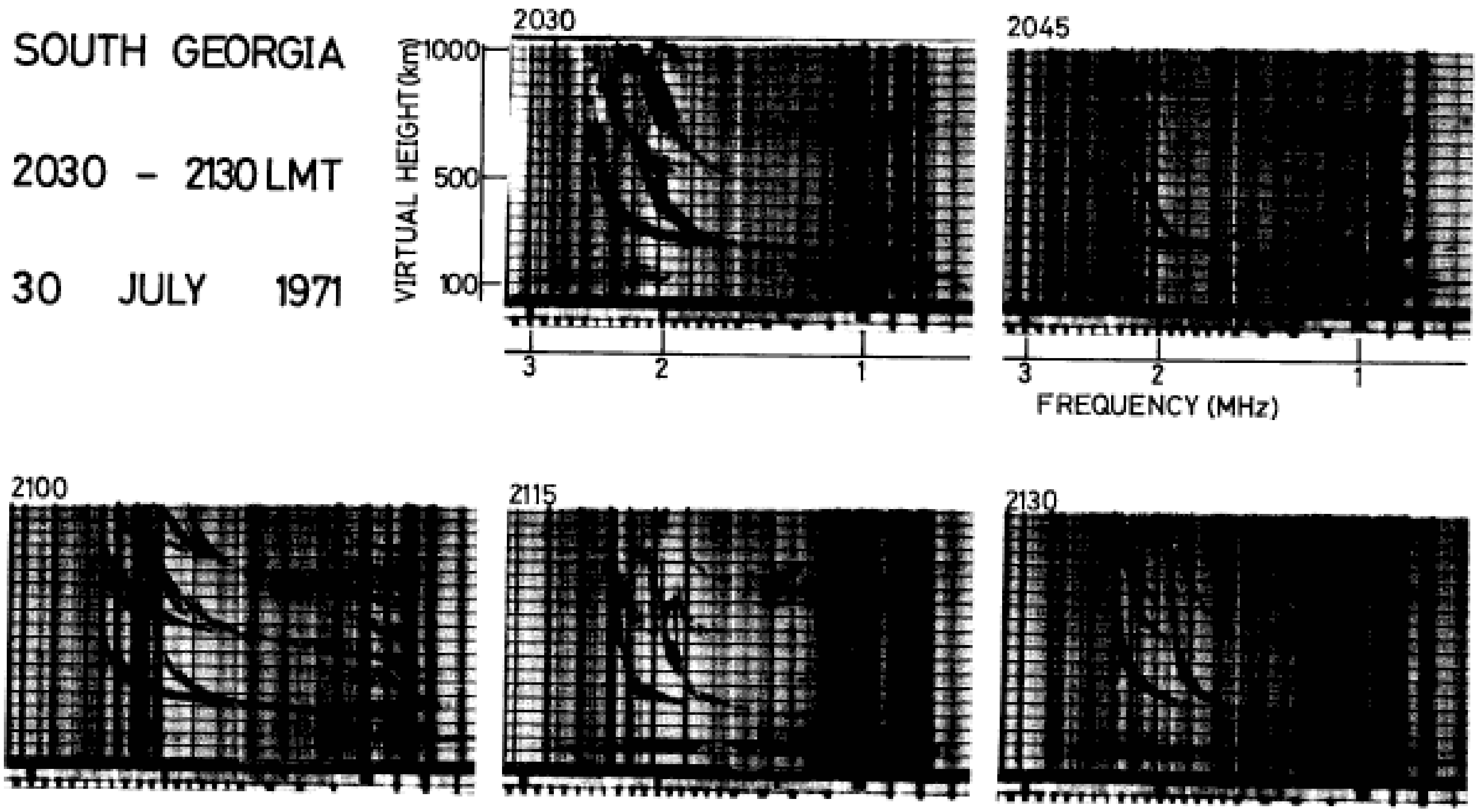
This type of sequence is consistent with the passage of travelling ionospheric disturbances, usually ascribed to gravity waves, travelling from South to North, i.e. towards the equator. These affect the highest levels first.

The first ionogram in the sequence shows the start of the perturbation as a broadening of the F-region trace near foF2 and fxF2. The second order trace shows this even more clearly. The x-mode trace on the 2045 ionogram is markedly different to the well-formed 0-trace, in particular showing an anomalous cusp at 1.2 MHz. This is a genuine feature and not the retardation usually associated with the electron gyrofrequency, which at South Georgia is only 0.8 MHz. The height and shape of the second order x—mode trace indicates that severe North-South tilts are present in the vicinity of the station.

SOUTH GEORGIA

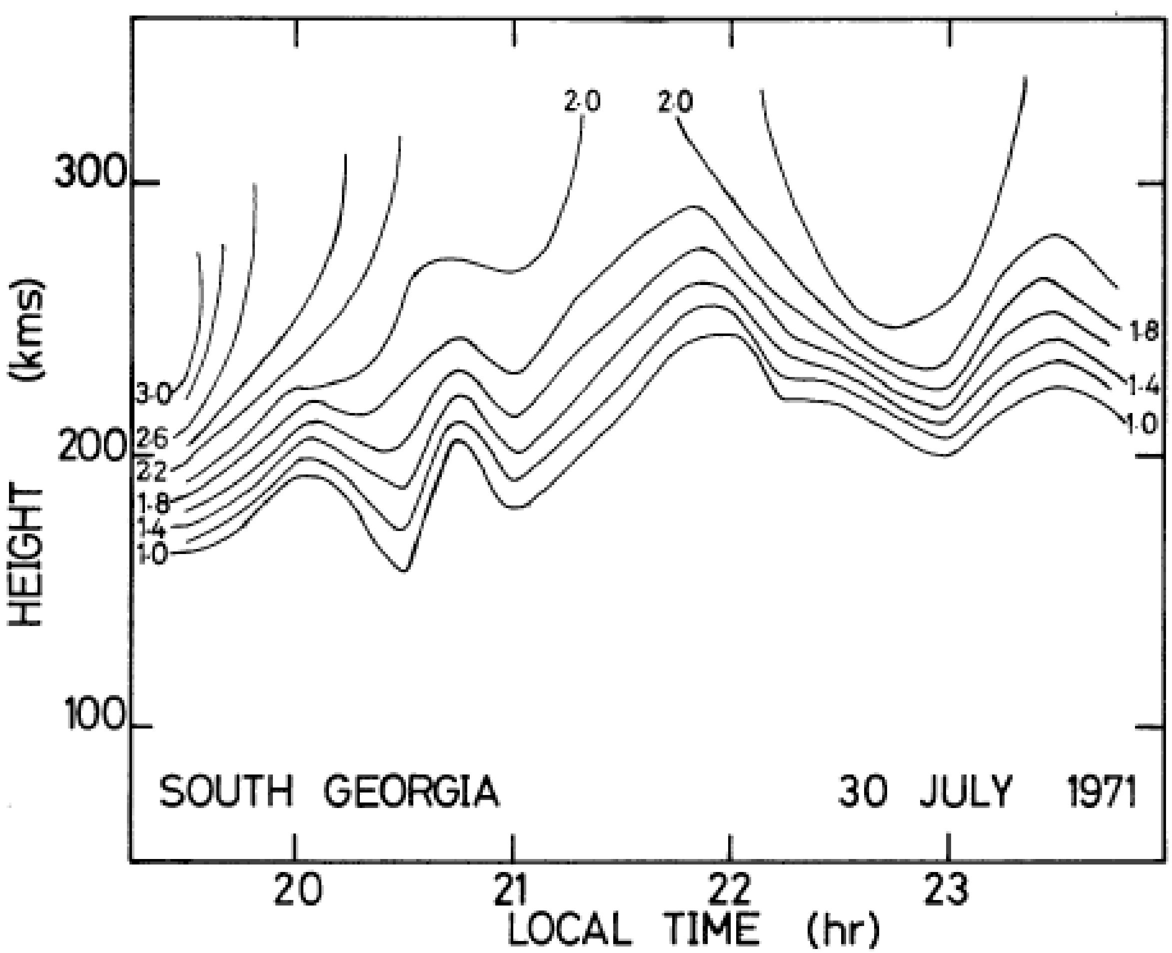
2030 - 2130 LMT

30 JULY 1971



At 2100 the relations between the heights of the multiple order F—region traces suggest that the layer has become horizontal. However, as can be seen in the table, both h'f and M(3000)F2 have decreased suggesting a change in layer shape, Checking near the tangent point for the MUF slider shows tilt near hmF2, as is confirmed by the satellite traces on the second and third orders. Thus the decrease in M factor is probably a tilt effect, a good example of how rapidly M factor and true height measurements become inaccurate when tilts are present. By 2230 the relations between multiples have become normal near hmF2, the factor is again reliable, the layer has moved up again lowering the factor. The 2115 and 2130 ionograms show changes similar to those found at 2030 and 2045.

To the accuracy allowed by the quarter hourly sampling intervals and the uncertainties in analysis when tilts are present, the sequence between 1930 and 2345 is consistent with the passage overhead of a sequence of relatively regular wave—like perturbations of height with time. These are seen more clearly on the isoionic contour plot shown in Figure 2, which was constructed using a semi—empirical



modelling technique using the tabulated data assuming it is from overhead. The characteristic movements towards lower heights with time are clear.

It is interesting to examine whether this wave train could be the effect of gravity waves excited by the movement of the terminator. At this time of year, the terminator is to the south of South Georgia, about 2000 km away and is relatively slightly inclined to the lines of latitude. The dip at South Georgia is abnormally small (-52°), this and the geometrical features of the station thus make it particularly favorable for observation of interactions between gravity waves and changes in F—region ionization. Local sunset is 1820 on this date, but if the hypothesis is true, the time of the passage to the effective part of the terminator will be later, since the wave train is travelling towards the equator. The direction of the F-region wind is also favorable for northwards transmission of any waves generated by the terminator in this period.

Other examples, somewhat less spectacular than this sequence, have been found at similar times on days neighboring this. Further weight is lent to this explanation since most polar to equator moving ionospheric disturbances are associated with auroral activity, however, solar and geophysical data for the week of this event show no outstanding features.

STATION SOUTH GEORGIA DATE 30 JULY 1970 UNITS: Mc/s AND Km

LMT	fmin	foEs	fbEs	foF2	h'Es	h'F	(M3000)F
19	007EE	013-Y	010	041	100	225	345
20	007EE	012	008	025	105	220	335
21	007EE	011	009	021	125	215	305
22	007	011	011	021	170	290-A	300UY
23	007	014	009	022	110	225	335

The sequence presented here highlights how much interesting information is lost if station operators and analysts look at ionograms solely to extract the routine scaling parameters. The scaling for the daily worksheet is shown in Figure 3. The only way of showing the presence of perturbations is to use UY for the M(3000) factor at 2100 — there was enough evidence to justify this on the ionogram though the original scaling missed this point. Such rapidly changing phenomena cannot be properly included in hourly table through an f plot would have shown some of the changes. For serious studies, a five minute sequence would have been desirable.

XVI. Correspondence Course

INAG invites other groups to submit training notes which may help other networks or scalers.

fxI and Spread - F Scaling, by: Alan Rodger, British Antarctic Survey

The parameter fxI and Spread-F types are now both extensively scaled and there appears to be few major difficulties in their scaling. However, at British Antarctic Survey (BAS) we have experienced some minor problems during our annual training program. These arise mainly when the o— and x-.mode traces are not identical which can occur for a variety of reasons and such as tilting of the ionosphere, differential absorption of the o— and x—wave and radio broadcast interference. The examples sheet with the appropriate scaling in the table were developed to illustrate some of the difficulties experienced.

The principle which is adopted in the scaling of fxI is that it should be determined in such a way that consistent values of foI can be deduced from it. This is more fully discussed in INAG 22, p. 8—9, and the difficulties of fxI and foI are given in UAG—23A p. 21 and p. 99—103.

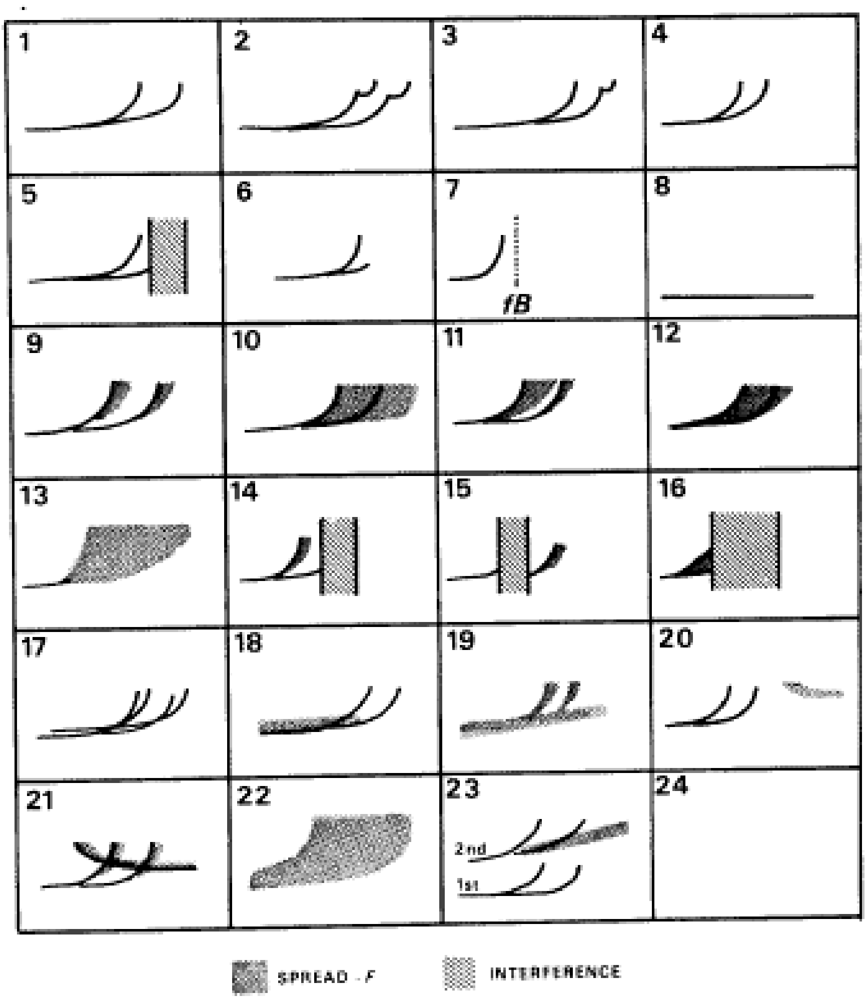
The optional Spread F rules in section 2.8, p. 58—63 of UAG—23A allow some flexibility in their interpretation. At BAS, our aim is to provide as complete description as possible by using the descriptive letters F, Q and P with foF2, fxI and h'F. Consequently we do not require to use the descriptive letter L to indicate the presence of mixed Spread—F. The descriptive letter F is used only when the frequency Spread—F ≥ 0.3 MHz. Range Spread-F (letter Q) is used when the recorded trace exceeds twice its normal width (a rule which is not universally accepted). When no Spread—F is observed on F—region traces, the descriptive letter X is given priority over all other to indicate the lack of scatter.

Ex.	foF2	fxI	h'F	Comment
1	044	050-X	250	Normal ionogram
2	044-H	050-X	250	No scatter present priority X on fxI
3	044	050-X	250	No scatter present, priority X on fxI
4	038EG	044-X	250	F2 region in G condition, fxI Ξ fxF1
5	044	0500X	250	fxI determined from o mode, priority X on fxI
6	044	0500X	250	fxI determined from o mode, priority X on fxI
7	010	016	250	fxF2 not seen as close to gyro-frequency
8	A	A	A	Complete blanketing by Sporadic E
9	044-F	053	250	Spread-F exceeds 0.3MHz; —F on fxI optional
10	044-F	057	250	More severe Spread—F than 9 but scaling similar different degree of Spread-F on o and x traces
11	044-F	0540B	250	fxI value determined from foI
12	044-F	0560B	250	More severe Spread F than 11 but similar scaling
13	044DF or F	060	250	Very severe Spread-F; resolution of o and x— traces not possible
14	044-F	0530S	250	fxI = foI + fB/2, with descriptive letter for interference
15	0443S	053-F	250	foF2 fxF2 — fB/2, Presence of Spread—F indicated on fxI
16	0380S	F	250	F given priority over other letters in fxI to show presence of Spread-F
17	044	053-X	250-Q	Simple range spread; no frequency spread hence —X
18	044	050-X	250-Q	Different form of range spread
19	044-F	058-Q	250-Q	fxI value determined from range spread structure
20	044	070-P	250	Polar spur gives fxI value
21	044-F	070-P	250	Polar spur gives fxI value
22	F	070	Q	Extensive mixed spread present

23	044	050-X		Ground backscatter trace, not used to evaluate fxI
24	B	B	B	Complete absorption

Note 1: Gyro-frequency taken as 1 .2 MHz
Note 2: Case 9, 10, 13 descriptive letter F optional use of fxI
Note 3: Case 5, 14—16 same scaling procedure applies if loss of traces caused by equipment malfunctions.

SPREAD - *F* AND *fxI* SCALING



XVII. Station Notes

Halley Bay, Antarctica

The routine 15—minute synoptic ionospheric sounding program which used a Union Radio Mk II ionosonde built in the early 1950s closed at the end of December 1980. Thus ending a nearly complete data set spanning over 23 years from a single model of ionosonde. An Advanced Ionospheric Sounder (INAG 28 p. 7, INAG 21 p. 14-15) was successfully deployed on the same site Mid—January despite a period of seasonably inclement weather. Some synoptic ionospheric parameters will be made available to the WDCs from this but the details have not yet been finalized.

Argentine Islands

A report describing the comparison of the data produced by an Australian 4A ionosonde (an early prototype of the IPS—42) and a Union Radio Mk II ionosonde, operated simultaneously at Argentine Islands over a 9 month period in 1978/79, is now available. Anyone wishing a copy should contact A. Rodger, British Antarctic Survey, Madingley Road, Cambridge CB3OET, U.K.

Chinese Stations

The Institute of Radio Wave Propagation has provided the following positions for the stations under its control. The station at the Wuhan Institute of Physics is operated by the Academy of Sciences.

Manzhouli	117° 27′ 18" E,	49° 35′ 10" N
Changchun	125° 15′ E,	43° 52′ N
Beijing	116° 08′ E,	39° 44′ N
Lanzhou	103° 51′ 50″ E,	36° 03′ 30″ N
Chongqing	106° 25' E,	29° 30′ 25″ N
Guongzhou	113° 21′ E,	23° 08′ 05″ N
Hainandao	110° 20′ 22″ E,	19° 59′ 50" N

Blumenau, Brazil

An ionospheric chirpsounder is located at 26°55' S 48°56' W working on the South Atlantic geomagnetic anomaly. This sounder belongs to the Communications Ministry of Brazil and is operating in a joint program with the FURB (University of Blumenau, Brazil).

XVIII. Resolutions and Decisions of 18th General Assembly of ICSU Amsterdam 1980

I.C.S.U., the International Council of Scientific Unions is the senior body in charge of all the International Scientific Unions. It can set up new Unions or Committees e.g. SCOSTEP, the Scientific Committee on Solar-Terrestrial Physics and approves Union rules and inter-Union relations.

Resolutions and Decisions which may be interesting to the Network and scientists using its data are:

3) Agreement between ICSU, the China Association for Science and Technology and the Academy located in Taipei, China

The 18th General Assembly of ICSU

endorses the recommendation made by the Executive Board at its 27th Meeting in May 1980 concerning the agreement between the China Association for Science and Technology, the Academy located in Taipei, China and ICSU, and

recommends that the Executive Board make every effort to ensure the participation in ICSU of the scientists from the People's Republic of China.

5) World Data Centres

The 18th General Assembly of ICSU,

noting that international geophysical programs are increasingly generating data sets which are largely, if not entirely, digital and machine readable, and therefore that it is of the greatest importance that the World Data Centres acquire the necessary equipment, procedures and personnel for the efficient processing, archiving and retrieval of data in large quantities in machine—readable form,

recognizing that the costs of maintaining the WDCs are borne entirely by those countries in which they are located, but that the Centres are required to meet the changing needs of the international scientific community as determined by the relevant Unions, Associations, Commissions and Committees of ICSU,

records its deep appreciation of the enormous service provided by the World Data Centres to the world scientific community,

invites the responsible National Agencies to consider ways and means of meeting the need for continued modernization of data-handling facilities in the WDCs.

8) COSTED and ICSU's Role in Development

The 18th General Assembly of ICSU,

aware of the growing interest in problems of the developing countries among members of the ICSU family, and of significant new initiatives by intergovernmental agencies, both of which were discussed in an open meeting on science and technology for development, in Amsterdam on 6 September 1980,

noting with approval the COSTED program for 1981, the intention to draw up a long—range program for 1982-84, the planned extension of COSTED activities in Africa and Latin America, and the rapidly increasing participation of many scientific Unions in fostering the growth of science and technology in developing countries, recommends that the Scientific Unions and COSTED improve and maintain close and continuing two-way communications concerning their respective programs and intentions for working with developing countries, invites national members to appoint national committees or correspondents for COSTED, who would help to identify: 1) problems where ICSU could be helpful; and 2) personnel and resources to strengthen COSTED's programs,

suggests that the Executive Board and the General Committee continue to consider ways and means of increasing the involvement of the world scientific and technological community in problems of developing, countries, and

suggests that the ICSU Executive Board authorize the preparation and publication of a concise readable booklet that would describe the activities of ICSU and its constituent bodies in the development area and characterize the kinds of services the ICSU family has to offer.

Note by Chairman: This resolution might offer a new way of getting some additional support for stations in developing countries which are at present in difficulties. However, requests should come from those actually involved - there is too much ill informed planning.

15) Commemoration of the First and Second Polar Years and the International Geophysical Year

The 18th General Assembly of ICSU,

remembering that the International Geophysical Year was an unprecedented step forward in world—wide scientific cooperation, and that it marked the beginning of many international programs in the earth sciences which ever since have progressed continuously,

reaffirms the decision to commemorate the centenary of the First Polar Year and the anniversaries of the Second Polar Year and the International Geophysical Year,

invites appropriate groups within ICSU, intergovernmental organizations and regional and national associations, to take this into account when planning their activities for 1982 and 1983, and

requests the Executive Board to include addresses on the history of international cooperation in earth sciences, and its relevance to future activities at the 19th General Assembly, to consider the publication of a special volume including the papers given at commemorative meetings, and to encourage the publicizing of the commemoration through the media.

16) The Need for Peaceful Resolution of International Disputes

The 18th General Assembly of ICSU,

aware of the imminent threat to the very survival of the human race inherent in the world-wide arms race,

remembering the call for peace issued 25 years ago in the Einstein-Russell Manifesto signed by nine other great scientists,

urges scientists everywhere to call upon their governments to work toward progressive limitation of weapons of mass destruction, and seek peaceful means for settling all matters of dispute between them.

XIX. Symposium on Scientific and Engineering Uses of Satellite Radio Beacons

A Symposium on Scientific and Engineering Uses of Satellite Radio Beacons was held in Warsaw, Poland, from 19 to 23 May 1980 at the invitation of the Space Research Committee of the Polish Academy of Sciences. It was the fifth Symposium of the COSPAR Beacon Satellite Group and was sponsored by COSPAR and URSI. The Symposium had the support of several eminent Polish personalities. The Organizing Committee and the Program Committee were chaired by Dr. A. W. Wernik.

The Symposium was fortunate in having the participation of 71 scientists from 18 countries. Following the tradition of the previous Symposia, some sessions were devoted to the presentation of 9 invited and 29 contributed papers, and others to discussions of the present status and future aspects of scientific and engineering uses of satellite radio beacons. Some of the topics were:

— Ionospheric disturbances (natural and artificial);
— Scientific uses of trans—ionospheric propagation studies;
— Tropospheric and ionospheric propagation limitations on earth/space systems;
- High—latitude ionospheric studies by radio beacon techniques;
— Equatorial ionospheric studies by radio beacon techniques;
— Mid—latitude ionospheric studies by radio beacon techniques;
— Plasmasphere/protonosphere studies;
— Techniques of radio beacon measurements;
- Application of beacon techniques to microwave and infrared sounding systems.

The Proceedings of the Symposium will be issued by the end of this year. Requests for spare copies should be addressed to:

Dr. A. W. Wernik, Space Research Centre PAN, ul. Ordona 21,
01-237 Warsaw, Poland.

R. Leitinger

Beacon Satellite Group

Since the COSPAR panel which was responsible for the Beacon Satellite Working Group has been dissolved, the URSI Board of Officers has decided to incorporate the Beacon Satellite Working Group as Working Group G 12 "Use of Beacon Satellite Transmission". This will be subject to confirmation at Washington.

XX. International Geophysical Calendar 1981

The Operational Edition of the Calendar (see following pages) has been issued by the International Ursigram and World Days Service (IUWDS) and copies are available on request from:

Dr. P. Simon,
Ursigrammes Observatoire,
92190 Meudon,
France,

or

Miss J. V. Lincoln,
WDC—A for Solar—Terrestrial Physics,
NOAA, 063,
325 Broadway, Boulder, Colorado 80303,
USA

On the back of the Calendar, there is a summary (not reproduced here) of the recommended observational programs in various branches of atmospheric physics and in studies of certain interplanetary phenomena.

International Geophysical Calendar for 1981

(See other side for information on use of this Calendar).

JANUARY

S	M	T	W	T	F	S
				1	2	3
4	5	6*	7*	8	9	10
11	12	13	14*	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEBRUARY

S	M	T	W	T	F	S
1	2	3	4*	5*	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

MARCH

S	M	T	W	T	F	S
1	2	3	4*	5*	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

APRIL

S	M	T	W	T	F	S
			1*	2*	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

MAY

S	M	T	W	T	F	S
					1	2
3	4	5*	6*	7	8	9
10	11	12	13*	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

JUNE

S	M	T	W	T	F	S
	1	2*	3*	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

JULY

S	M	T	W	T	F	S
			1*	2*	3	4
5	6	7	8	9	10	11
12	13	14	15*	16	17	18
19	20	21	22	23	24	25
26	27	28	29*	30*	31	

AUGUST

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12*	13	14	15
16	17	18	19	20	21	22
23	24	25	26*	27*	28	29
30	31					

SEPTEMBER

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29*	30*			

OCTOBER

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28*	29*	30	31

NOVEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18*	19	20	21
22	23	24	25*	26*	27	28
29	30					

DECEMBER

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23*	24*	25	26
27	28	29	30	31		

JANUARY 1982

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

13 Regular World Day (RWD)

14 Priority Regular World Day (PRWD)

18 Quarterly World Day (QWD) also a PRWD and RWD

2 Regular Geophysical Day (RGD)

4 Day of Solar Eclipse

14* Incoherent Scatter Coordinated Observation Day

5* Dark Moon Geophysical Day (DMGD)

9 10 World Geophysical Interval (WGI)

[3 Day with unusual meteor shower activity, Northern Hemisphere

5] Day with unusual meteor shower activity, Southern Hemisphere

3 4 Airglow and Aurora Period

NOTES:

1. Solar Maximum Year Continues through February 1981, but with possible extension through September 1981.

2. An Alpine Experiment (ALPEX), of the WMO/ICSU World Climate Research Program, is scheduled for the period 1 September 1981 through 30 September 1982.

OPERATIONAL EDITION, August 1980

(see other side)

EXPLANATIONS

This Calendar continues the series begun for the IGY years 1957-58, and is issued annually to recommend dates for solar and geophysical observations which cannot be carried out continuously. Thus, the amount of observational data in existence tends to be larger on Calendar days. The recommendations on data reduction and especially the flow of data to **World Data Centers (WDCs)** in many instances emphasize Calendar days. The Calendar is prepared by the **International Ursigram and World Days Service (IUWDS)** with the advice of spokesmen for the various scientific disciplines. For greater detail concerning explanations or recommendations, your attention is called to information published periodically in **IAGA News, IUGG Chronicle, URSI Information Bulletin** or other scientific journals.

The definitions of the designated days remain as described on previous Calendars. **Universal Time (UT)** is the standard time for all world days. **Regular Geophysical Days (RGD)** are each Wednesday. **Regular World Days (RWD)** are three consecutive days each month, always Tuesday, Wednesday and Thursday near the middle of the month. **Priority Regular World Days (PRWD)** are the RWD which fall on Wednesdays. **Quarterly World Days (QWD)** are one day each quarter and are the PRWD which fall in the **World Geophysical Intervals (WGI)**. The **WGI** are fourteen consecutive days in each season, beginning on Monday of the selected month, and normally shift from year to year. In 1981 the **WGI** will be March, June, September and December.

The **Solar Eclipses** are February 4-5 (annular) beginning in the Great Australian Bight, crossing Tasmania, ending in the South Pacific Ocean off the coast of Peru, and July 31 (total) beginning in the eastern part of the Black Sea, crossing the central part of Asia, and ending in the Pacific Ocean north of the Hawaiian Islands.

Meteor Showers (selected by P. M. Millman, Ottawa) include important visual showers and also unusual showers observable mainly by radio and radar techniques. The dates are coded to indicate whether the shower is observable in the northern or southern hemisphere.

The occurrence of unusual solar or geophysical conditions is announced or forecast by the IUWDS through various types of geophysical "**Alerts**" which are widely distributed by telegram and radio broadcast on a current schedule. Stratospheric warmings (**STRATWARM**) are also designated. The meteorological telecommunications network coordinated by WMO carries these worldwide Alerts once daily soon after 0400 UT. For definitions of Alerts see IUWDS "Synoptic Codes for Solar and Geophysical Data, Third Revised Edition 1973" and its amendments. **Retrospective World Intervals** are selected and announced by MONSEE and elsewhere to provide additional analyzed data for particular events studied in the ICSU Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) programs.

RECOMMENDED SCIENTIFIC PROGRAMS
OPERATIONAL EDITION

(The following material was reviewed in 1980 by spokesman of INAG, WMO and COSPAR as suitable for coordinated geophysical programs in 1981.)

Airglow and Aurora Phenomena. Airglow and auroral observatories operate with their full capacity around the New Moon periods. However, for progress in understanding the mechanism of, inter alia, low latitude aurora, the coordinated use of all available techniques, optical and radio, from the ground and in space is required. Thus, for the airglow and aurora 7-day periods on the Calendar, ionosonde, incoherent scatter, special satellite or balloon observations, etc., are especially encouraged. Periods of approximately two weeks' duration centered on the New Moon are proposed for high resolution studies of ionospheric, auroral and magnetospheric observations at high latitudes during northern winter.

Atmospheric Electricity. Not-continuous measurements and data reduction for continuous measurements of atmospheric electric current density, field, conductivities, space charges, ion number densities, ionosphere potentials, condensation nuclei, etc.; both at ground as well as with radiosondes, aircraft, rockets; should be done with first priority on the **RGD** each Wednesday, beginning on 7 January 1981 at 1800 UT, 14 January at 0000 UT, 21 January at 0600 UT, 28 January at 1200 UT, etc. (beginning hour shift six hours each week, but is always on Wednesday). Minimum program is at the same time on PRWD beginning with 14 January at 0000 UT. Data reduction for continuous measurements should be extended, if possible, to cover at least the full RGD including, in addition, at least 6 hours prior to indicated beginning time. Measurements prohibited by bad weather should be done 24 hours later. Results on sferics and ELF are wanted with first priority for the same hours, short-period measurements centered around the minutes 35-50 of the hours indicated. **Priority Weeks** are the weeks which contain a PRWD; minimum priority weeks are the ones with a QWD. The World Data Centre for Atmospheric Electricity, 7 Karbysheva, Leningrad 194018, USSR, is the collection point for data and information on measurements.

Geomagnetic Phenomena. It has always been a leading principle for geomagnetic observatories that operations should be as continuous as possible and the great majority of stations undertake the same program without regard to the Calendar.

Stations equipped for making magnetic observations, but which cannot carry out such observations and reductions on a continuous schedule are encouraged to carry out such work at least on **RWD** (and during times of **MAGSTORM** Alert).

Ionospheric Phenomena. Special attention is continuing on particular events which cannot be forecast in advance with reasonable certainty. These will be identified by Retrospective World Intervals. The importance of obtaining full observational coverage is therefore stressed even if it is possible to analyze the detailed data only for the chosen events. In the case of vertical incidence sounding, the need to obtain quarter-hourly ionograms at as many stations as possible is particularly stressed and takes priority over recommendation (a) below when both are not practical.

For the vertical incidence (VI) sounding program, the summary recommendations are: (a) all stations should make soundings at least every quarter hour. Stations which normally record at every quarter should, if possible, record more frequently on **RWDs**; (b) all stations are encouraged to make f-plots on **RWDs**; f-plots should be made for high latitude stations, and for the so-called "representative" stations at lower latitudes for all days (i.e., including **RWDs** and **WGIs**). (Continuous records of ionospheric parameters are acceptable in place of f-plots at temperate and low latitude stations); (c) all stations are encouraged to make profile parameters on **RWDs** and include them in data sent to WDCs except for stations which already undertake full profile programs or produce monthly median profiles for synoptic purposes; (d) copies of hourly ionograms with appropriate scales for **QWDs** are to be sent to WDCs; (e) stations in the eclipse zone and its conjugate area should take continuous observations on solar eclipse days and special observations on adjacent days. See also recommendations under **Airglow and Aurora Phenomena**.

For incoherent scatter observation program, every effort should be made to obtain measurements at least on the **Incoherent Scatter Coordinated Observation Days**, and intensive series should be attempted whenever possible in **WGIs** or the **Airglow and Aurora Periods**. The need for collateral VI observations with not more than quarter-hourly spacing at least during all observation periods is stressed. Dr. M. Blanc (France), URSI Working Group G.8, is coordinating special programs.

For the ionospheric drift or wind measurement by the various radio techniques, observations are recommended to be concentrated on the weeks including **RWDs**.

For traveling ionosphere disturbances propose special periods for coordinated measurements of gravity waves induced by magnetospheric activity, probably on selected **PRWD** and **RWD**.

For the ionospheric absorption program half-hourly observations are made at least on all **RWDs** and half-hourly tabulations sent to WDCs. Observations should be continuous on **solar eclipse** days for stations in eclipse zone and in its conjugate area. Special efforts should be made to obtain daily absorption measurements at temperate latitude stations during the period of Absorption Winter Anomaly, particularly on days of abnormally high or abnormally low absorption (approximately October-March, Northern Hemisphere; April-September, Southern Hemisphere).

For back-scatter and forward-scatter programs, observations should be made and analyzed on all **RWDs** at least.

For synoptic observations of mesospheric (D region) electron densities, several groups have agreed on using the **RGD** for the hours around noon.

For ELF noise measurements involving the earth-ionosphere cavity resonances any special effort should be concentrated during the **WGIs**.

It is recommended that more intensive observations in all programs be considered on days of **unusual meteor activity**.

Meteorology. Particular efforts should be made to carry out an intensified program on the **RGD** — each Wednesday, UT. A desirable goal would be the scheduling of meteorological rocketsondes, ozone sondes and radiometer sondes on these days, together with maximum altitude rawinsonde ascents at both 0000 ad 1200 UT.

During **WGI** and **STRATWARM** Alert intervals, intensified programs are also desirable, preferably by the implementation of **RGD**-type programs (see above) on Mondays and Fridays, as well as on Wednesdays.

Solar Phenomena. The Solar Maximum Year continues through February 1981. Observatories making specialized studies of solar phenomena, particularly using new or complex techniques, such that continuous observation or reporting is impractical, are requested to make special efforts to provide to WDCs data for **solar eclipse** days, **RWDs** and during **PROTON/FLARE ALERTS**. The attention of those recording solar noise spectra, solar magnetic fields and doing specialized optical studies is particularly drawn to this recommendation.

Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy. Experimenters should take into account that observational effort in other disciplines tends to be intensified on the days marked on the Calendar, and schedule balloon and rocket experiments accordingly if there are no other geophysical reasons for choice. In particular it is desirable to make rocket measurements of ionospheric characteristics on the same day at as many locations as possible; where feasible, experimenters should endeavor to launch rockets to monitor at least normal conditions on the **Quarterly World Days (QWD)** or on **RWDs**, since these are also days when there will be maximum support from ground observations. Also, special efforts should be made to assure recording of telemetry on **QWD** and **Airglow and Aurora Periods** of experiments on satellites and of experiments on spacecraft in orbit around the Sun.

For the URSI/IAGA Working Group on Passive Electromagnetic Probing of the Magnetosphere augmented synoptic recordings will be called for on an ad hoc basis in June and July 1981.

For URSI/IAGA Coordinated Tidal Observations Program (CTOP) contact Dr. R. G. Roper (USA) for the 1981 calendar.

The International Ursigram and World Days Service (IUWDS) is a permanent scientific service of the International Union of Radio Science (**URSI**), with the participation of the International Astronomical Union and the International Union Geodesy and Geophysics. IUWDS adheres to the Federation of Astronomical and Geophysical Services of the International Council of Scientific Unions. The IUWDS coordinates the international aspects of the world days program and rapid data interchange.

This Calendar for 1981 has been drawn up by J. V. Lincoln, of the IUWDS Steering Committee, in close association with A. H. Shapley, Chairman of MONSEE of SCOSTEP, and spokesmen for the various scientific disciplines in SCOSTEP and COSPAR. Similar Calendars have been issued annually beginning with the IGY, 1957-58, and have been published in various widely available scientific publications.

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Additional copies are available upon request to IUWDS Chairman, Dr. P. Simon, Ursigrammes Observatoire, 92190 Meudon, France, or IUWDS Secretary for World Days, Miss J. V. Lincoln, WDC-A for Solar-Terrestrial Physics, NOAA, D63, 325 Broadway, Boulder, Colorado 80303, U.S.A.

XXI. Changes in the SCOSTEP Secretariat

As of 31 December 1980 Dr. E. R. Dyer, Jr. will be retiring from the position of Scientific Secretary of SCOSTEP. His successor will be:

Prof. C. H. Liu,
Department of Electrical Engineering,
University of Illinois,
Urbana, IL 61801
USA

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During the period of 1 Jan - 15 June 1981, Prof. Liu will be on sabbatical leave and Prof. C. F. Sechrist at the same address will be Acting Secretary.

As of 15 December 1980, all correspondence should be sent to the Urbana address.